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Table 4

**SECONDARY MARKET POTENTIAL AS OF OCTOBER 1, 1983:
US UTILITIES HAVING 3½ YEAR CONTRACTS
(thousands of SWUs)**

Utility	FY84	Origin Sought or Current Status	FY85	Origin Sought or Current Status
A	130	Will sign ISC	0	
B	160	DOE or Eurodif	150	DOE or Eurodif
C	130	Terminated		
	640	DOE or Eurodif	560	DOE or Eurodif
D	150	DOE or Eurodif	0	
E	220	DOE	210	Signed ISC
F	360	Signed ISC	50	Signed ISC
G	390	Will sign ISC	0	
H	0		160	DOE or Eurodif
I	0		140	DOE or Eurodif
J	60	DOE or Eurodif	60	DOE or Eurodif
TOTAL US	2,240		1,330	

Table 5

**SECONDARY MARKET POTENTIAL AS OF OCTOBER 1, 1983:
NON-US UTILITIES WITH 3½ YEAR CONTRACTS
(thousands of SWUs)**

Region	FY84	Origin Sought Or Current Status	FY85	Origin Sought or Current Status
All Europe	150	DOE or Eurodif	120	DOE or Eurodif
All Japan	540	Expected to sign ISC	550	Expected to sign ISC

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CURRENT MARKET DATA

EXCHANGE VALUE $24.00/lb. U_3O_8
Determined as of September 30, 1983

Definition[1]

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

[1]In December, 1981, Nuexco published a history of the Exchange Value which chronicled, month-by-month, changes in its definition, usage and derivation. Copies are available upon request.

TRANSACTION VALUE[2]
Determined as of September 30, 1983

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
23.65	2.0	21	6

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

Comments

Nuexco does not consider the following in determining the Transaction Value:

A. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.
B. The price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of Exchange Value or any other independent variable. Also excluded from consideration are all data where the delivery price is defined in such a way that it cannot currently be determined.

[2]Transaction Values for 1976 through 1981 and their associated parameters (millions of pounds, number of transactions and number of months) are tabulated on pages 31 and 32 of Report 161. Corresponding data for 1982 are tabulated on page 5 of Report 173.

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CURRENT MARKET DATA

LOAN USE CHARGE RATE[2] 6%
Determined as of September 30, 1983

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.
B. Rates included in firm proposals to borrow or lend.
C. Rates that potential borrowers and lenders have expressed as a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

[2]Monthly data for 1968 through 1981 appear on pages 32-34 of Report 162. Monthly data for 1982 appear on page 2 of Report 173.

CONVERSION VALUE[1] $1.00/lb. U as UF_6
Determined as of September 30, 1983

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and/or near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.
B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.
C. Transportation charges other than those customarily provided by primary suppliers of conversion services.

[1]Monthly data for 1981 and 1982 are tabulated on page 6 of Report 173.

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SWU VALUE $90/SWU for FY84
Determined as of September 30, 1983

Definition

The SWU (Separative Work Unit) Value is Nuexco's judgment of the price, expressed in US dollars per SWU, at which transactions for the sale of significant quantities of SWU of any origin for delivery in the specified DOE fiscal year could be concluded as of the last day of the month.

Derivation

Nuexco bases the SWU Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.
E. SWU prices at varying tails assays and varying product assays are converted to the equivalent SWU price at the DOE Reference Transaction Tails Assay (presently 0.20 weight percent U_{235}) and a product assay of three percent U_{235} assuming feed costs calculated using the Nuexco Exchange Value and Nuexco Conversion Value determined as of the last day of the same month.

Comments

Nuexco does not consider the following in determining the SWU Value:

A. The price of SWU delivered under long-term contracts from primary suppliers, such as DOE, Urenco, or Eurodif.
B. The price of SWU delivered under other than arm's length transactions.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
Australia (dollar)	26.74	58.95	69.52
Belgium (comm. franc)	1,284	2,831	3,338
Canada (dollar)	29.59	65.23	76.92
Finland (markka)	136.29	300.46	354.31
France (franc)	192.62	424.65	500.76
FRG (mark)	63.41	139.79	164.85
Italy (lira)	38,400	84,657	99,831
Japan (yen)	5,683	12,529	14,775
Netherlands (guilder)	70.88	156.26	184.27
South Africa (rand)	26.45	58.30	68.75
Spain (peseta)	3,653	8,053	9,497
Sweden (krona)	188.09	414.66	488.99
Switzerland (franc)	51.15	112.77	132.98
UK (pound)	16.03	35.34	41.68
US (dollar)	24.00	52.91	62.39

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
Australia (dollar)	26.35	58.09	68.51
Belgium (comm. franc)	1,265	2,790	3,290
Canada (dollar)	29.15	64.27	75.79
Finland (markka)	134.30	296.08	349.15
France (franc)	189.81	418.45	493.46
FRG (mark)	62.48	137.75	162.44
Italy (lira)	37,840	83,423	98,376
Japan (yen)	5,600	12,347	14,559
Netherlands (guilder)	69.85	153.98	181.59
South Africa (rand)	26.06	57.45	67.75
Spain (peseta)	3,600	7,936	9,358
Sweden (krona)	185.34	408.61	481.86
Switzerland (franc)	50.40	111.12	131.04
UK (pound)	15.80	34.83	41.07
US (dollar)	23.65	52.14	61.48

[1]Calculated using currency exchange rates published in the Wall Street Journal on September 30, 1983.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6	per kg U as UF_6
Australia (dollar)	1.11	2.46
Belgium (comm. franc)	53.50	117.96
Canada (dollar)	1.23	2.72
Finland (markka)	5.68	12.52
France (franc)	8.03	17.69
FRG (mark)	2.64	5.82
Italy (lira)	1,600	3,527
Japan (yen)	236.80	522.05
Netherlands (guilder)	2.95	6.51
South Africa (rand)	1.10	2.43
Spain (peseta)	152.21	335.56
Sweden (krona)	7.84	17.28
Switzerland (franc)	2.13	4.70
UK (pound)	0.67	1.47
US (dollar)	1.00	2.20

SWU VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	FY 1984 per SWU
Australia (dollar)	100.28
Belgium (comm. franc)	4,815
Canada (dollar)	110.95
Finland (markka)	511.07
France (franc)	722.31
FRG (mark)	237.78
Italy (lira)	44,000
Japan (yen)	21,312
Netherlands (guilder)	265.80
South Africa (rand)	99.17
Spain (peseta)	13,699
Sweden (krona)	705.33
Switzerland (franc)	191.82
UK (pound)	60.12
US (dollar)	90.00

[1]Calculated using currency exchange rates published in the Wall Street Journal on September 30, 1983.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
2474	1984	101-300	less than 108	unknown	European Entity	UF_6
2493	1983	less than 50	102	US Producer	US Producer	

Uranium Loans

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current C.V.	Lender	Borrower	Remarks
none reported						

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
2473	1984	101-300	102	US Utility	US Utility	

Secondary Market Enrichment Services

Nuexco Transaction Number	Delivery Period[2]	Approximate Quantity (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value	Tails Assay (Percent U_{235})	Seller Group	Buyer Group	SWU Origin	Remarks
2458	1983	40	123	unknown	US Utility	US Utility	DOE	
2491	1984	60	109	.2	European Utility	US Utility	DOE	
2492	1984	100	less than 102	.2	See remarks	US Utility	DOE	Seller identity withheld to protect confidentiality

[1]Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2]Refers to quarter of calendar year, not fiscal year.
[3]Price is not normalized to 0.20% tails assay.

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URANIUM SUPPLY
(As of 9/30/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term[3]	Remarks
Available for Sale:			
ACTIVE			
1575	—	500 per year	long term
1818	—	250 per year	long term
2017	—	2,300	
2038	2,000	—	UF_6
2134	—	250 per year	1984-87
2201	300	—	
2203	1,200	—	
2220	150	—	UF_6
2235	—	100 per year	1985-87
2236	—	200 per year	1985-89
2245	450	—	
2246	40	100	
2275	70	—	
2288	80	—	UF_6
2297	60	200 per year	1985-89
2307	900	—	UF_6
2309	1,000	—	
2315	450	—	UF_6
2315A	—	950	UF_6
2320	350	—	UF_6
2332	150	—	U_3O_8 or UF_6
2365	20	—	
TOTAL:	7,220		
INACTIVE			
1877	40	—	
2118A	300	—	U_3O_8 or UF_6
2121	600	—	
2271	—	500 per year	1984-88
2191	125	—	UF_6
2193	—	800 per year	1986-90
2274	—	500 per year	1985-91
TOTAL:	1,065		

[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
[3]For delivery beyond one year.

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CURRENT MARKET DATA

URANIUM DEMAND
(As of 9/30/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term[3]	Remarks
Inquiries to Purchase:			
ACTIVE			
1459	—	200 per year	1985 on
1995	270	—	enriched UF_6
2010	—	400 per year	1984-92
2115	—	250 per year	1985 on
2167	250	250 per year	1984-99
2187	150	—	
2188	—	250 per year	1985 on
2233	700	—	1984, U_3O_8 or UF_6
2266	450	—	
2304	—	500 per year	1988 on
2310	800	—	enriched UF_6
2313	—	200	
2316	150	—	UF_6
2317	550	—	
2329	—	500	
2352	1,010	—	U_3O_8 or UF_6
2393	45	—	enriched UF_6
2416	—	430	
TOTAL:	4,375		
INACTIVE			
1999	—	50 per year	1985-90
2025	—	350	
2114	—	75 per year	1984 on
2244	—	350 per year	1985 on
TOTAL:			

[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
[3]For delivery beyond one year.

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CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(As of 9/30/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8)		Remarks
	Within 1 Year	Beyond 1 Year	
Available for Loan:			
ACTIVE			
1815	1,000		UF_6
1938	1,500		UF_6
2128	1,500		
TOTAL:	4,000		
INACTIVE			
1884	600		
2036	500		UF_6
2139	2,000		
TOTAL:	3,100		
Inquiries to Borrow:			
ACTIVE			
2118	250		U_3O_8 or UF_6
TOTAL:	250		
INACTIVE	None		

[1]Measured from the date of this Report

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CURRENT MARKET DATA

CONVERSION SUPPLY
(As of 9/30/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6)		Remarks
	Within 3 Years	Beyond 3 Years	
ACTIVE			
1840	130	—	
1936	1,500	200 per year	long term
2051	1,500	—	
2141	1,500	—	
2143	300	—	
2220	400	—	
2222	80	175	
TOTAL:	5,410		
INACTIVE			
1609	1,500	—	
2181	2,000	650 per year	long term
2230	300	—	
TOTAL:	3,800		

CONVERSION DEMAND
(As of 9/30/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6)		Remarks
	Within 3 Years	Beyond 3 Years	
ACTIVE			
2129	900	—	
2188	—	200 per year	1985 on
2199	100	—	
2328	800	—	
TOTAL:	1,800		
INACTIVE			
2190	400	200 per year	1986 on
2194	—	300 per year	1986 on
2199	650	—	
2295	220	—	
TOTAL:	1,270		

[1]Measured from the date of this Report.

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ACTIVE SWU SUPPLY
(As of 9/30/83)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term[3]	Remarks
1859	—	5,000	
1971	—	250	
1984	120	—	
2100	—	200	
2192	—	410	
2273	100	150	
2285	950	6,000	
2375	200	—	
2385	300	—	
TOTAL:	1,670		

ACTIVE SWU DEMAND
(As of 9/30/83)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term[3]	Remarks
1850	—	500	
1856	—	500	
1860	240	760	
2233	250	—	
2237	—	150 per year	84 and beyond
2254	130	—	
2265	140	—	
2272	—	200	
2282	—	300	
2310	200	—	
2318	—	150	
2358	—	100	
2362	150	—	
2393	15	—	
2415	130	—	
2417	180	—	
TOTAL:	1,435		

[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
[3]For delivery beyond one year.

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RECENT DEVELOPMENTS

CANADA

In September the Canadian government announced that export contracts now can be approved for up to 15 years. Previously contracts could not exceed ten years. The announcement followed the completion of the government's review of uranium export policy.

Canada aims to guarantee security of supply for domestic utilities. This minor liberalization of the policy is attributable to the growth of national production and to historical cutbacks in projected domestic demand for uranium. Other aspects of the export policy were left unchanged. The government reaffirmed its longstanding pricing policy, specifically the requirement for a floor price. It also reaffirmed the policy requiring the upgrading of U_3O_8 to UF_6 before export, so long as Eldorado can supply the necessary services and its price for conversion is competitive on the international market.

* * *

In Report 181 (September 1983) Nuexco reported an anomaly after two CANDU reactors experienced problems in one week during August. The number of recent problems with CANDUs has escalated. From early August through mid-September, Ontario Hydro has encountered six leaks or spills at its Pickering, Douglas Point and Bruce generating stations. Several of these were small or routine problems, but the fact that they happened together has generated a series of press reports in Canada. The most serious occurrence was a cracked pressure tube in Pickering Unit 2. The crack reportedly was caused by corrosion and therefore raises the question of whether this is a generic problem with CANDUs. The raising of the issue comes at a bad time. CANDU has been pushing new sales to Korea, Romania, and elsewhere, and a key selling point is CANDU performance and reliability.

JAPAN

For some years the peak power demand for the nine Japanese public utilities has occurred in the summer. According to the Federation of Electric Companies successive records for power generation were established in the summer of 1983. On July 26, 1983 a new record of 94,772 utilize feed and SWUs of non-US origin in their reactors. of 99,337 MW on August 5.

The new generation records were attributed to increased industrial demand due to improvement in the economy, as well as to an unusually hot summer, which prompted increased use of air conditioning. Japan's 24 commercial nuclear units concurrently have established a new record for availability. The reactors, which in 1982 generated approximately 20 percent of Japan's electricity while representing 13 percent of installed capacity, in August for the first time achieved an availability factor of 80.6 percent.

SPAIN

Two new units were connected to the Spanish grid in September, increasing available nuclear generating capacity to 3,800 MWe. Asco I and Almaraz II, both 930 MWe PWRs, are operating smoothly under 18 month testing licenses. Almaraz I, which began commercial operation in 1981 but had a capacity factor of only 30.7 percent in 1982 because of steam generator problems, is operating again after the completion of repairs and alterations.

UNITED STATES

The long-awaited Oak Ridge meeting to discuss the new DOE Utility Services enrichment contract (USEC) has been delayed until at least mid-November. A special DOE enrichment task force has not yet completed its review of the USEC, advanced technology options, pricing policies, and other topics. Decisions on these issues, desirable before the Oak Ridge meeting, will not be made before mid-October. DOE currently plans to allow two weeks for customers to review the contract before the meeting.

Testimony presented during July by the Congressional Budget Office (CBO) to the Congressional Subcommittee on Energy Research and Production reviewed the costs of technological options under consideration by DOE.

1. Under Option 1, the eight-building Gas Centrifuge Enrichment Plant (GCEP) complex would be completed and would use current technology. GCEP SWU production would begin in 1988 and reach full capacity by 1997, replacing approximately 50 percent of existing gaseous diffusion capacity.

2. Option 2 would utilize the Atomic Vapor Laser Isotope Separation (AVLIS) process. Laser enrichment would begin in 1994 and supplant gaseous diffusion capacity by 1999.

3. Option 3 would continue construction of the eight-building GCEP complex, as would Option 1, but set III and set IV centrifuge machines would be replaced completely in the 1990s by much more efficient set V machines.

The CBO's analysis concluded that Option 3 would be most economical, followed by Option 2 and Option 1. The CBO estimated average lifetime enrichment costs in 1983 dollars per SWU to be approximately $27 for Op-

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tion 3, $31 for Option 2, and $39 for Option 1. By comparison, the marginal unit cost of existing gaseous diffusion enrichment is approximately $95.

The repeated delays of the Oak Ridge meeting have promoted speculation and discussion of the USEC at a number of meetings of concerned industry personnel. Several have focused on the contract and its relationship to future enrichment alternatives. These people are wondering whether commitments to fund the continued development of advanced enrichment technologies in the hope of future cost reductions will cause DOE's competitive position in the primary SWU market to deteriorate.

The USEC also has emerged as an issue during the Energy Information Administration's (EIA) investigation into the viability of the US uranium industry. Some proponents of government restrictions on the importation of non-US uranium argue that, if the EIA determines that the industry is not viable, Section 161V of the Atomic Energy Act of 1954 requires DOE to stop enriching non-US uranium. This issue raises the concern of domestic utilities. If they convert to the USEC, they could be foregoing the freedom to buy non-US enrichment services, either in primary or secondary markets. If limited to DOE SWU supply, US utilities also could be required ultimately to use only domestic supplies of uranium. Presently all US nuclear utilities are allowed to utilize feed and SWUs of non-US origin in their reactors.

CORRECTION

An error appeared in Report 181 for September 1983 in the article entitled "Australia's Potential as a Uranium Producing Nation." In the third paragraph on page 23 the article states that Teton Exploration Co. owns 25.5 percent of the Honeymoon project in South Australia. Teton, a subsidiary of UNC, sold its share of Honeymoon in March 1983. Presently CSR owns 34.23 percent and MIM owns 65.77 percent of Honeymoon.

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COMMENTARY

SWU POLICY ISSUES

Nuexco's review of trends in the enrichment services market has raised a number of issues concerning future SWU prices. This article will not attempt to resolve those issues. Rather, it will summarize some of the most important questions for the consideration of our readers.

Price Projections

Various government agencies have reported apparently conflicting projections for DOE SWU prices.

1. In June of this year, the DOE issued a forecast of enrichment prices (in FY83 dollars) which showed a steady decline from the current $138 per SWU to about $112 in 1995. [United States Enrichment News, DOE, June 1983]

2. More recently, the DOE issued an even more favorable forecast, with prices as low as $70.00/SWU (in FY85 dollars) in 1995 declining to "about $50.00/SWU or less by the year 2000" if the Atomic Vapor Laser Isotope Separation (AVLIS) system meets expectations. ["New Enrichment Technology—What Can the Customer Expect?"; Fourth Annual Pacific Basin Nuclear Conference; Vancouver]

3. The Congressional Budget Office (CBO) has published an independent analysis, which agrees with DOE that the employment of either the advanced gas centrifuge or the atomic vapor laser technologies will result in lower enrichment costs in the long run (42 years). However, the CBO estimates average DOE costs for 1983-95 at *$230-$240 per SWU (in FY83 dollars).* [Nuclear Fuel; May 9, 1983]

4. The General Accounting Office (GAO), in a separate analysis of future DOE costs, has questioned the cost effectiveness of the Gaseous Centrifuge Enrichment Project (GCEP). Using DOE methods, but lower estimates of enrichment demand and power cost escalation, the GAO reports ". . . there are apparently no definite long-range cost reduction benefits associated with constructing GCEP. However, even if one accepts the position that building GCEP is economical, building the plant would not begin to reduce the average customer price for SWUs until after 1992." [Issues Concerning DOE's Justification for Building the GCEP", GAO/EMD-82-88, May 25, 1982, and Supplement GAO/EMD-82-88S, June 24, 1983]

QUESTION: As the Atomic Energy Act requires the full recovery of costs through revenues, what effect will the conflicting cost forecasts have on future DOE SWU prices?

Financial Analysis

As a result of the apparent conflict between the various government agencies on future DOE costs, it would seem worthwhile to investigate further the DOE cost structure. DOE prices are currently established on a complex system of cost accounts over a rolling 10-year period, and a complete analysis requires considerable effort. However, a cursory analysis of the 1984 DOE budget [United States Enrichment News, DOE, June 1983] indicates that further study is merited.

Total cash outlays in 1984, per the DOE budget, are $2.24 billion, or about $190/SWU for the 12 million SWU to be produced in 1984. After adding imputed interest and depreciation charges of $43/SWU, the total cost of a SWU produced in 1984 appears to be $233, within the $230-240 range of the CBO's estimated average SWU costs for 1983-1995.

Conclusion

The actual price of future DOE enrichment services will be the result of complex calculations involving expected future costs and enrichment demand. In addition, past price projections may have given very conservative treatment to technological improvements. Thus, there may be legitimate reasons for the apparent discrepancies in future price projections. However, as the DOE is required by law to obtain full cost recovery, its customers should develop a better understanding of the DOE cost structure prior to making significant decisions on future enrichment services.

The anticipated Utility Services enrichment contract will most likely require DOE customers to accept only DOE SWUs for the long term and forego the opportunities to seek competing supplies from foreign enrichers. Whether it is in a utility's best interests (and those of its stockholders and ratepayers) to forego the long-term benefits of competition in return for near-term price concessions is an issue of fundamental concern to utility managers, their supervisors, and regulatory authorities. Answers to this question and others raised in this article will be important to those utilities facing SWU market decisions in the next few months. Not all parties are likely to arrive at the same conclusions.

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SUMMARY OF DOE SWU CONTRACTS

This article reviews the principal terms and conditions of six types of US Department of Energy (DOE) enrichment services contracts.

1. Requirements (two types);
2. Short-term Fixed-commitment (STFC);
3. Adjustable Fixed-commitment (AFC);
4. Draft Facility Requirements (FR);
5. Interim Sales (ISC).

Requirements Contracts

Requirements contracts, offered between 1968 and 1972, were the first so-called toll enrichment contracts offered by the US Atomic Energy Commission (now DOE). Their name is derived from the option customers have to take only their actual enrichment requirements from DOE. From the customer's viewpoint, the requirements contract is the best contract form ever offered by DOE.

Covering enrichment needs for at most thirty years, all requirements contracts expire between 1988 and 2012. Under the terms of the contract, the customer agrees, at least in theory, to purchase from DOE all SWU requirements for the reactor covered by the contract. However, the contracts' provisions for termination without charge after a relatively short minimum rolling period (free termination) make the *effective term* either 3.5 or five years (less if termination charges are paid), much shorter than the theoretical *maximum term* of thirty years. At the end of the contract term, the customer is free to use SWUs of any origin.

The contract feature most important to the secondary market is that providing for *free termination*. For any given year beyond the minimum rolling period, a customer may partially terminate a requirements contract; that is, may specify a zero SWU requirement. The requirements contracts first offered by the AEC specified a minimum rolling period of 3.5 years, while the later form increased the period to five years. Thus, the two types of contracts are commonly called **5-year requirements** and **3.5-year requirements** contracts.

During the minimum rolling period, when free termination is precluded, the customer may terminate by paying charges specified in the contracts. *Termination charges* are assessed as a percentage of SWU contract price and vary according to the amount of advance notice given.

Upon contract execution (or at least six months before the year of first delivery), DOE and the customer must have agreed upon the estimated annual enrichment requirements over the life of the contract, as documented in an appendix to the contract. Those estimated requirements (Appendix A), cumulated to the year of delivery, constitute the quantity ceiling above which the customer does not have to take and DOE does not have to provide required enrichment services. Adjustments to Appendix A can be made later upon mutual agreement of both DOE and the customer. As a practical matter, DOE customarily allows downward adjustments in the Appendix A requirements if the customer can demonstrate that the adjusted amounts will cover anticipated requirements. Unapproved or late adjustments may be subject to charges for partial termination. If the number of SWUs must be increased—that is, if the reactor's requirements are greater than anticipated—DOE usually will agree to deliver the extra SWUs, provided that the necessary production capacity is available.

Every year, on January 1st for US customers and on November 1st for non-US customers, the contract holder must provide a *non-binding notice* of estimated annual SWU requirements for the minimum rolling period (5 or 3.5 subsequent years). Under current practices, DOE also asks that customers provide estimates of their requirements for five to ten subsequent years. As part of the annual non-binding notice, the customer will also provide an estimate of the number of SWUs in every month of the two subsequent years. While the information provided by the customer is not contractually binding, the notice must include proposed dates for deliveries, allowing at least 90 days between feed deliveries and withdrawals for the corresponding SWU deliveries.

At least 180 days in advance of SWU withdrawal, the customer issues to DOE a *binding notice* of the specific assays of feed and enriched product, and feed product quantities for a specific delivery. (The maximum enriched product and minimum feed assays must be within the assays specified in the DOE Standard Table of Enriching Services.) This is called a "firm-up" statement in that the 180-day notice becomes binding and may only be eliminated by termination (at a substantial charge) prior to SWU withdrawal. The current transaction tails assay under the Requirements Contract is 0.2 percent, subject to change by DOE on 180 days notice. (Requirements contracts do not offer the variable tails assay option.)

Table 6 shows the termination charges associated with various notice periods for the two different types of requirements contracts.

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Table 6

TERMINATION CHARGES UNDER REQUIREMENTS CONTRACTS
(percent of SWU price for terminated SWUs)

Notice (years)	5-Year Requirements	3.5-Year Requirements
0-1	40 percent	25 percent
1-2	40 percent	20 percent
2-3	40 percent	20 percent
3-3.5	40 percent	15 percent
3.5-5	40 percent	0 percent
over 5	0 percent	0 percent

Another important feature of the requirements contracts is the inclusion of a *price ceiling*. The price for SWUs under this type of contract may not exceed a base price adjusted for escalation in power and labor costs (.75 x Power Index + .25 x Labor Index). During the 1970s, it was not uncommon for the ceiling price to be lower than the full cost recovery price. However, for the past few years, the ceiling price has not been limiting.

Payment for the delivery of SWUs must be made within 30 days of the DOE invoice date. This term was extended to 60 days for those holders of 3.5-year requirements contracts that accept the ISC offer except for deliveries in August and September 1983. Requirements contract *prices* (currently $149.85 for both 5-year and 3.5-year contracts) have usually exceeded AFC contract prices, but there is no apparent relationship between them.

Fixed-Commitment Contracts

The first fixed-commitment contract offered by DOE was the **Long-term Fixed-commitment (LTFC)** contract. It was basically a rolling ten-year take-and-pay contract. While a few such contracts still exist, the LTFC contract is no longer a significant factor in the market for enrichment services.

The **Short-term Fixed-commitment (STFC)** contract, offered for 10 months in 1974-75, was developed as a companion contract to the LTFC. Originally intended to allow fabricators to purchase small amounts of enrichment services, DOE later broadened its policy to allow the use of the STFC in all contracting situations unsuitable for long-term contract. The STFC was subsequently used as the foundation for the Interim Sales Contract recently offered to 3.5-year requirements contract holders.

The **Adjustable, Fixed-commitment (AFC)** contract replaced the LTFC contract in the late 1970s. It was DOE's response to customers' pleas for relief from excessive enrichment obligations caused by cutbacks in their nuclear programs.

In late 1982, DOE released the draft of a new contract form, the **Facility Requirements (FR)** contract. The revised version, unissued as of this writing, is to be entitled the **Utility Services enrichment contract (USEC)**. Although reported to be completely different from the FR draft, it is more likely that the USEC will be similar in many respects when issued.

Numerous contract provisions are common to the STFC, AFC, and FR (draft) contract types.

1. The customer must define the proposed month(s) of delivery at least **314** days in advance. The customer may also request specific delivery dates within the delivery month(s).

2. DOE must notify the customer of the firm date(s) of delivery at least **240** (275 in the FR draft) days prior to the beginning of the delivery month(s).

3. At least **180** days in advance of the firm SWU delivery date(s), the customer must specify the final quantities and assays (maximum enriched product and minimum feed assays to be within the assays specified in the DOE Standard Table of Enriching Services) of feed and product to be delivered.

4. A load-leveling provision allows DOE to alter delivery dates by up to two months, based on the values of three ratios calculated monthly. (The ratios relate to the distribution of DOE's scheduled SWU production over the six months preceding scheduled delivery.)

5. DOE may increase the 314, 240, and 180-day periods when the calculated ratios of monthly average demand exceed certain limits for an estimated month of delivery.

6. Feed deliveries to DOE must precede related SWU deliveries by 90 to 180 days as DOE may elect.

7. The price is the DOE fixed-commitment price in effect on the date of delivery.

8. Termination charges applicable to fixed-commitment type contracts are published in the Federal Register and revised periodically.

Termination Charges

The termination charges for fixed-commitment contracts (FC) are determined as percentages of the price of all terminated SWUs as of the date DOE received the termination notice. These percentages depend on the lead time given and the fiscal year the notice is given. These termination charges usually preclude secondary market purchases.

The termination charges for fixed-commitment con-

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tracts are reported in the Federal Register. Table 7 shows the charges reported in the notice dated November 28, 1980. A minimum charge is due, even if the number of SWUs affected by the termination of a given year's deliveries is zero. The minimum termination charge is equal to (0.2 N P), where N is the number of years terminated and P is the sum of prepayments due or effected for each gross MWe of contracted plant capacity. For those contracts which required no prepayment, P is set at $3,300/MWe.

Table 7

TERMINATION CHARGES FOR DOE FIXED-COMMITMENT CONTRACTS

Advance Notice Period (Years)	Termination Charge (Percent of SWU Price) if notice is received in FY				
	83	84	85	86	87+
0.0-0.5	51.5	47.5	43.2	38.6	33.5
0.5-1.5	43.9	40.0	35.7	31.0	26.0
1.5-2.5	36.9	33.0	28.6	24.0	19.0
2.5-3.5	30.5	26.5	22.2	17.5	12.5
3.5-4.5	24.5	20.5	16.2	11.5	6.5
4.5-5.5	18.9	15.0	10.7	6.0	1.0
5.5-6.5	13.8	9.9	5.6	0.9	0.0
6.5-7.5	9.1	5.1	0.8	0.0	0.0
7.5-8.5	4.7	0.6	0.0	0.0	0.0
8.5-10.5	0.7	0.0	0.0	0.0	0.0

STFC

The STFC contract is a short-term, take-and-pay contract. It must be executed no more than two years in advance of the DOE fiscal year of first delivery, but at least 180 days in advance of the month of first delivery. The STFC contract has a maximum term of 3 years, but may also be limited to just one SWU delivery, in which case the secondary market may be more advantageous. At time of execution, the customer and DOE agree on an enriching services schedule (Appendix A). This schedule defines the number of SWUs to be delivered in each **year** of the contract. At time of contract execution or at least six months prior to the fiscal year of first delivery, the customer must provide the estimated quantities of feed and assays of product (and notice of intention to use any enriched feed) to be delivered each **month** of the two subsequent years. This information is documented in another appendix (Appendix B), but is not contractually binding. Actual deliveries are firmed up by written notice 315 days in advance.

Adjustable Fixed-commitment (AFC) Contract

DOE introduced this type of contract in 1978 to replace the Long-Term Fixed-Commitment (LTFC) contract. The two contracts are essentially identical but for two major exceptions.

1. The rolling delivery period to be specified by the customer was reduced from 10 to 5 years.

2. Within the rolling period, DOE granted more flexibility with respect to the number of SWUs delivered in a given year and to the tails assay.

The AFC contract may be executed for a minimum period of 10 years and a maximum period to the lifetime of a reactor. Execution of the contract must be 6-10 years before the fiscal year of first delivery. An advance payment of $4,656 (possibly a different sum if a contract was executed after 1979) per estimated generated MWe is due in two installments. The first installment ($600 per MWe) is due upon contract execution. The second installment (balance minus interest on first installment) is due 6 years prior to the first fiscal year of delivery. The prepayment accrues interest and is later applied against the first balance(s) due for the services provided. Additional payments, if any, are to be made within 30 days of the DOE invoice date.

Annual SWU requirements are firmed-up on a five year rolling period. Since the commitment for the fifth year is provided 15 months in advance of the first year of the five year rolling period, the contract actually contains six years of firm commitments documented in Appendix A. There are, however, some allowances for quantity flexibility. The fifth year of the rolling five year period is subject to +/-20 percent flexibility in the SWU commitment, and the fourth year is subject to +/-10 percent. Total quantity variation exercised for both years may not exceed +/-20 percent. The appendix also requires nonbinding estimates for the five years following the fifth year of the rolling period.

Included with its annual submissions, the customer must provide estimates of tails assays corresponding to the Appendix A SWU commitments. In addition, estimated *monthly* quantities and assays for the subsequent three year period must be given.

As part of the AFC contract, the customer may elect the variable tails assay option (VTAO) at least 15 months prior to the fiscal year of withdrawal. The VTAO allows the selection of tails assays between 0.16 percent and 0.30 percent. DOE may assess an efficiency loss penalty for tails assays below 0.2 percent, but the penalty has never yet been applied. This information is contractually binding.

The AFC contract contains two mechanisms by which

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a customer may obtain relief from excess SWU commitments. Prior to firming up the appendices, a customer may *delay* the initial delivery period (the first 5 years of commitments) as many times as needed for up to 5 cumulative years, paying one-fifth of the advance payment for each year delayed. Delay is the less expensive of the two mechanisms and is exercised by several utilities.

The second relief provision is the *deferral* option. Under this provision, upon 15 to 47 months advance notice, the customer can defer a delivery (and all succeeding deliveries) up to 5 years each time, as many times as needed. The charge for deferral is the difference in discounted cash flows resulting from the schedule adjustment. The discount rate to be used in the analysis is that in effect at the time of election as determined annually by DOE. The SWU price is the fixed-commitment price in effect at the time (currently $138.65).

Another important feature of the AFC contract is the substitution provision. When the customer specifies his SWU commitments for the fifth year of the rolling period, he may elect to reduce his requirements by the use of other DOE-enriched material (from his inventory or the secondary market). In effect, this option is available on a 6¼ year lead time. An active assignment market existed for several years as utilities reduced expected excess inventories through this mechanism.

Facility Requirements (FR) Contract (Draft Of August, 1982)

The draft Facility Requirements (FR) contract offered DOE customers more flexibility, but at the cost of stronger penalties for contract terminations. DOE plans to release later this year a second version containing such drastic changes that it has been given a new name: the Utility Services enrichment contract (USEC).

The FR contract draft differed from the AFC contract in four important respects:

1. Reduced advance payments;
2. Shorter committed rolling period;
3. Heavy penalties for contract termination, similar to those applied to AFC contract termination. For a complete contract termination, the applicable number of terminated SWUs could be based on as many as ten years.
4. Requirements could be reduced through substitution of material originally enriched by DOE upon an advance notice of 30 months prior to the beginning of the year of delivery.

Interim Sales Contract

It had become possible for holders of 3.5-year requirements contracts to achieve substantial savings by participating in the secondary SWU market. The mechanism used was the partial termination of their 3.5 year requirements contract. Even after paying the DOE termination charges (10-25 percent of the contract price per SWU), these buyers could buy secondary market SWUs to replace their terminated DOE deliveries and save enough money to justify the effort. Following private negotiations with at least two utilities, and after some hesitations caused by legal and policy questions, DOE offered the Interim Sales Contract (ISC) to all holders of 3.5-year requirements contracts.

The ISC is essentially a STFC contract modified to reflect a special 60-day payment term and 180-day notice on quantities and assays of feed and enriched product. It offers any 3.5-year requirements contract holder willing to waive the right to terminate and agree to take all FY83-85 SWU requirements from DOE a price reduction of approximately $11.20 per SWU. It reduces their price for FY83-85 from the requirements contract price (currently $149.85) to the fixed-commitment contract price (currently $138.65). It also doubles the payment term from 30 days to 60 days (except for deliveries that took place in August and September 1983). Although no termination for 83-85 SWUs is allowed after a DOE customer accepts the ISC, its net commercial effect has been to reduce the break-even price from $112.39 to $101.19 (see Report 180), and correspondingly to reduce the secondary market SWU price.

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CURRENT URANIUM FORECASTS

This report presents the results of Nuexco's most recent analyses of nuclear electric generating capacity, apparent future consumption, uranium production, and the supply and demand balance in the Free World through 1992. Five observations about the nuclear power business lend credibility to these current forecasts.

1. Most of the nuclear power plants in the Free World are operational or under construction; relatively few are on order or planned. As the proportion of operational capacity has increased relative to the total capacity forecast, the predictability of the resultant uranium consumption has increased.

2. Fuel requirements can be estimated accurately on the basis of plant operating records.

3. Industry experience with governments and societies makes it possible to anticipate reactor delays and cancellations.

4. The development of a truly international uranium market has made it more difficult for governments to impose successful controls.

5. Uranium resources are adequate to meet all foreseeable need, and operating production facilities are reasonably secure after surviving the severe price fluctuations of the past decade.

The current market environment contrasts with the uncertainty Nuexco faced when preparing previous forecasts. The huge surpluses of uranium and fuel services acquired over the past decade, which have depressed prices so dramatically, are being reduced as consumption increases relative to production. Furthermore, those excess inventories are being redistributed by the operation of secondary markets.

FORECAST OF APPARENT FUTURE CONSUMPTION

Introduction

Nuexco's forecast of nuclear electric generating capacity as of September 30, 1983, presented in Table 8, provides the basis for the forecast of apparent future consumption of U_3O_8, quantified in Table 9. Nuexco expects Free World capacity to double by 1992 and consumption to increase by 45 percent.

The term *consumption* refers to *Nuexco's estimate* of the U_3O_8 which will be processed, fabricated and installed for the operation of a given nuclear power unit. Consumption comprises a portion of overall uranium demand commonly referred to as reactor demand or reactor requirements. Apparent future consumption should be distinguished from the unfilled requirements for uranium which nuclear power plant operators can be expected to purchase in the future. Unfilled requirements, which comprise the active market demand for uncommitted production, depend on current inventories, existing supply contracts, and individual utility procurement practices.

Methodology

The forecast of nuclear electric generating capacity is based on an in-depth, country-by-country analysis of the probability that reactors presently operational, under construction, on order or planned will operate commercially during the next ten to fifteen years. Many of the considerations on which Nuexco bases its projection of capacity growth will not have important effects on consumption until after the ten year period covered in the current forecast. Considerations that figure prominently in longer-term projections include:

1. electrical load growth;

2. the economics of nuclear power compared to alternate means of electricity generation;

3. the financial condition of utilities and their capacity to adjust to high interest rates and rising construction costs;

4. national and international regulations, weapons safeguards and public opinion.

These longer-term considerations are less important in the forecast through 1992 because nuclear programs in most countries are firm for the next several years. In the USA and in many other nations, no future orders for nuclear units are likely to increase uranium consumption during the forecast period. The forecast does include provisions for some planned reactors in France and Japan because of the relatively short construction cycles prevalent in those countries, and because planning and approval processes there are such that substantial site and engineering work is done before actual orders are placed. The primary factors involved in Nuexco's forecast of installed capacity are:

1. construction progress to date on individual nuclear units and expected completion dates;

2. the size of those units;

3. anticipated delays due to regulatory action or design modifications;

4. the political, social and regulatory environment affecting each unit.

The subjective nature of some of these immediate considerations is reflected in a comparison of Nuexco's judgment with the projections of governments and other institutions. Nuexco's forecast is approximately 20 percent below cumulative national plans for nuclear generation in the nine countries having the largest nuclear programs in the Free World.

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Nuexco calculates apparent future consumption of U_3O_8 as a function of several reactor-specific variables.

1. *Reactor thermal power.* While the capacity forecast is expressed in terms of net electrical output, the calculation for consumption uses the design thermal output.

2. *Capacity factor.* Based on a tabulation of historical performance data over the period 1968-1982 and on expected future improvements in performance for five reactor types, Nuexco assumes capacity factor values shown in Table 10.

Table 10

Nuclear Plant Capacity Factor Assumptions

Reactor Type	Percent
Boiling water reactor (BWR)	60-65[1]
Pressurized water reactor (PWR)	60-65[1]
Heavy water reactor (HWR)	75
Gas-cooled reactor (GCR)	55
Advanced gas-cooled reactor (AGCR)	60

[1]Increases linearly over period 1982-1992.

3. *Fuel utilization improvements.* In LWRs which entered service after December 1968, technical improvements, principally extended fuel exposure, lead to reductions in consumption. The reductions are offset, however, by the transition to eighteen-month cycles, which will cause consumption to increase slightly during the forecast period. Modest improvements for heavy water reactors are expected by 1990 through the use of slightly enriched uranium (1.20 percent U_{235}) in reload fuel. No improvements are assumed for gas-cooled reactors.

4. *Refueling intervals.* U_3O_8 deliveries for first cores predate commercial operation by two years. (Some first cores, particularly for US nuclear units, have been fabricated in advance of this schedule and are not included in the calculation of apparent future consumption.) Delivery of first reload predates refueling outage by 12 months, and refueling intervals range between 12 and 18 months, depending on individual reactor schedules.

5. *Process losses.* 0.5 percent of the U_3O_8 being converted is lost during conversion.

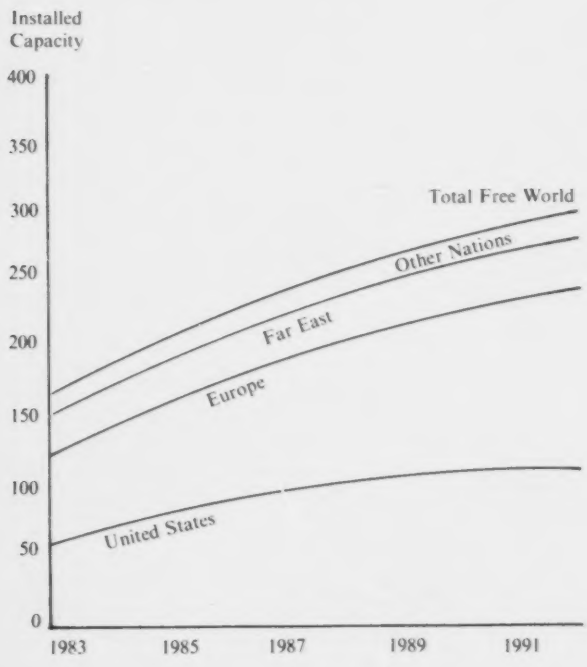

Figure 1
Free World Nuclear Electric Generating Capacity
(GWe or Thousands of MWe Net)

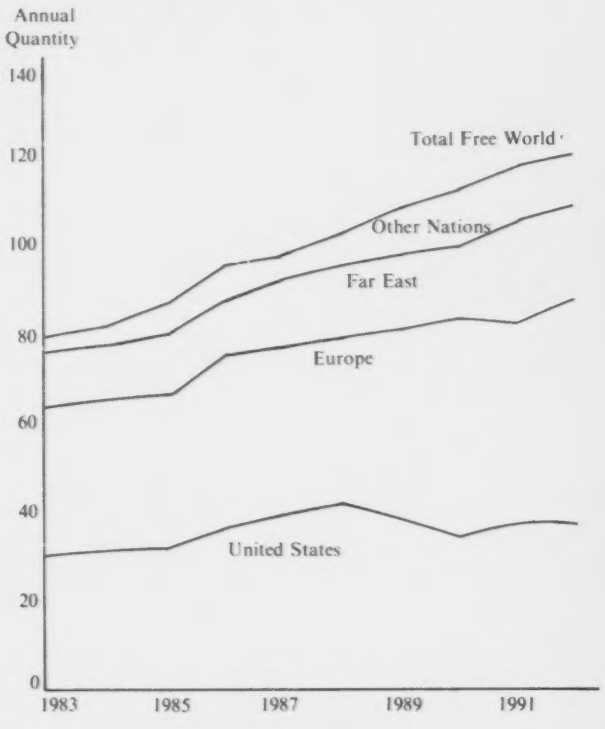

Figure 2
Free World Uranium Consumption
(Millions of Pounds U_3O_8 Equivalent)

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6. *Enrichment tails assay.* The forecast assumes a tails assay of 0.25 percent U_{235}, representing Nuexco's judgment of the approximate average enrichment plant tails assay expected in the future. While DOE requirements contracts specify tails assays of 0.20 percent, holders of DOE adjustable fixed commitment (AFC) contracts, using the variable tails assay option (VTAO), are free to choose levels up to 0.30 percent. A low cost of feed material relative to high cost of SWU could allow a utility to save substantial amounts of money by exercising the VTAO.

7. *Fuel enrichment levels.* Average levels are based on known reactor specifications.

8. *Recycled fuel.* Although several countries reprocess spent nuclear fuel, the amont of recycled fuel probably will not be significant over the forecast period.

Table 8

NUCLEAR ELECTRIC GENERATING CAPACITY[1]
(thousands of MWe—net)

BUYER GROUP	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
United States	60.4	67.8	77.5	83.9	88.5	95.8	102.6	108.3	110.8	110.8
Europe	65.6	70.9	81.1	91.6	101.1	106.6	109.8	113.6	118.6	125.2
Far East[2]	21.0	22.6	26.8	30.6	34.4	37.0	38.3	41.3	46.0	48.5
Other Free World[3]	9.1	11.4	13.6	15.1	15.1	16.5	17.2	18.3	20.2	23.0
FREE WORLD TOTAL	156.1	172.7	199.0	221.2	239.1	255.9	268.9	281.5	295.6	307.5

[1]Uses Nuexco's estimate of commercial operating dates.
[2]Japan, Korea, Taiwan, Philippines.
[3]Excludes Bulgaria, Czechoslovakia, German Democratic Republic, Finland (two Russian Reactors), Hungary, People's Republic of China, Poland, Romania, USSR.

Table 9

APPARENT FUTURE CONSUMPTION[1]
(millions of pounds U_3O_8)

BUYER GROUP	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
United States	28.9	29.5	30.6	36.4	38.6	39.9	38.9	37.6	39.4	38.4
Europe	34.3	36.6	38.3	40.2	38.8	41.6	43.8	47.6	45.6	51.6
Far East[2]	12.0	12.3	13.7	13.5	14.5	14.7	18.3	17.9	21.4	19.2
Other Free World[3]	4.4	4.3	4.6	5.6	5.3	5.7	7.3	7.3	7.8	6.6
FREE WORLD[3] TOTAL:	79.6	82.7	87.2	95.7	97.2	101.9	108.3	110.4	114.2	115.8

[1]Computed quantities of U_3O_8 which would be used under the given conditions to fabricate fuel for loading and reloading reactors that are operating, under construction, or on order as of September 30, 1983. Compiled and computed on a reactor-specific basis, quantities for each reactor are based on specific core characteristics, 0.25% tails assay, no recycling, 24-month lead time for procuring first cores and 12 month lead time for procuring each reload. Estimates reflect annual consumption displaced in time to the start of the conversion-enrichment-fabrication cycle for timely loading into the reactor; they do not reflect refueling cycles. Some initial cores have been fabricated for units still under construction; uranium for these cores is not included in the data.
[2]Japan, Korea, Taiwan, Philippines
[3]Excludes Bulgaria, Czechoslovakia, German Democratic Republic, Finland (two Russian Reactors), Hungary, People's Republic of China, Poland, Romania, USSR.

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FORECAST OF URANIUM PRODUCTION

Results of Analysis

Nuexco's current forecast of Free World uranium production is quantified in Table 11. Based on an analysis of production centers that are operating, shut down temporarily, under construction and planned, Nuexco projects Free World uranium production of approximately 119 million pounds per year by the end of the forecast period.

Canada, rapidly expanding production in Saskatchewan (Report 181), has become the world's largest producer. Although some large uranium projects will be delayed into the next decade, the development and expansion of high-grade orebodies outside the USA will continue to increase Free World production. Other characteristics of production outside the USA are listed below.

1. Most non-US producers have long-term contracts, many of which call for negotiated prices, so low spot market prices affect them more slowly and to a lesser extent than US producers.

2. Captive production in regions like Central Africa remains somewhat protected from market forces, but Nuexco expects the sustained low-price trend to lead to reductions in some areas.

3. Uranium-gold co-product and by-product mining in South Africa will remain profitable as long as gold prices are not severely depressed.

4. Some older non-US commercial facilities will be phased out due to the same pressures of high cost and low grade which have affected US producers. However, decreases in production will be more than offset by increased production from high-grade reserves in Canada and Australia.

In 1983, US production will be only 38 percent of the 1980 peak of almost 43 million pounds U_3O_8. Nuexco expects the USA to increase annual production to approximately 21 million pounds U_3O_8 by 1990, one fifth of the Free World total. New production facilities will account for less than 10 percent of total US output by 1987.

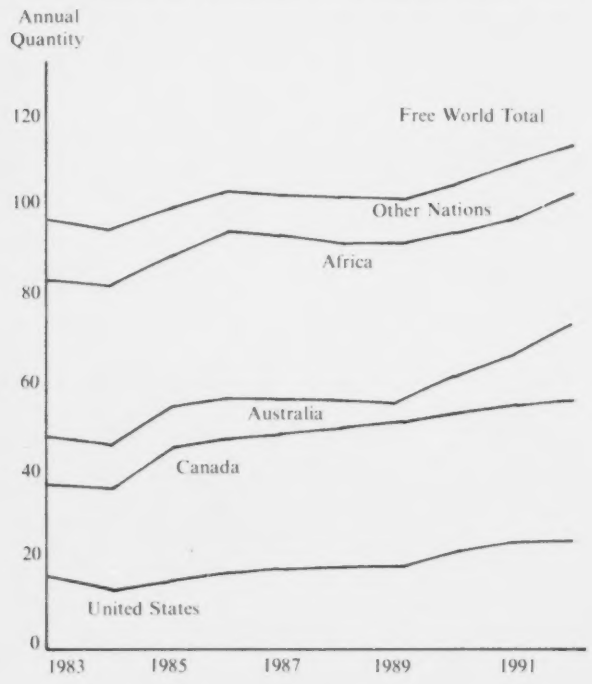

Figure 3
(Millions of Pounds U_3O_8 per Year)
Free World Uranium Production Forecast

Methodology

The production forecast is based on Nuexco's analysis of the following factors as they apply to individual projects:

1. quantity and grade of ore;
2. *variable costs* for production facilities that are financially established, and *full costs* for projects in the planning stage;
3. producers' financial conditions;
4. existing supply contracts;
5. the feasibility of obtaining new supply contracts;
6. political and regulatory environment.

Finally, Nuexco's production forecast is based on the premise that long-term prices for U_3O_8 will rise to stimulate enough production to satisfy demand.

SUPPLY AND DEMAND ANALYSIS

Results

Nuexco's most recent forecasts of production and consumption are compared in Table 12. The resulting supply-demand balance suggests that the uranium industry is on the verge of intermediate-term to long-term stability. Several conclusions may be drawn from the analysis.

1. Table 12 shows the forecast of world production of U_3O_8 exceeding consumption in each year through 1988, but, after 1985, by less than ten million pounds annually. During the first half of the ten-year forcast period, the relatively small cumulative imbalance between supply and demand will be relieved by annual additions to inventory.

2. During the second half of the forecast period, the situation will be reversed, as consumption exceeds production. However, the relatively insignificant supply shortfalls will be filled by withdrawals from inventory.

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Table 11

FREE WORLD URANIUM PRODUCTION FORECAST
(millions of pounds U_3O_8)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Canada	20.9	24.9	32.1	31.4	31.9	31.9	31.9	31.9	31.6	31.6
United States	16.3	12.2	15.3	17.1	17.2	18.2	18.3	20.9	22.5	22.3
Australia	10.5	10.5	10.5	10.5	10.5	9.2	8.0	10.0	12.8	17.6
Republic of South Africa	15.6	16.3	16.8	17.0	17.1	17.3	17.5	17.4	17.4	17.0
Namibia	9.8	10.0	8.5	8.2	6.5	6.5	6.5	6.5	6.5	6.5
Central Africa[1]	11.2	10.2	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
France	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Other Nations[2]	2.4	2.8	2.8	2.9	2.9	2.9	2.7	2.4	3.1	3.8
TOTAL FREE WORLD[3]	95	95	104	105	104	104	103	107	112	119

[1]Niger and Gabon
[2]Argentina, Belgium, Brazil, Chile, Mexico, Portugal, Spain and others
[3]Rounded to nearest million pounds U_3O_8.

Table 12

FREE WORLD URANIUM BALANCE
(millions of pounds U_3O_8 equivalent)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
BEGINNING INVENTORY	408.9[1]	424.0	436.2	452.7	461.8	468.4	470.2	464.5	460.9	458.3
plus PRODUCTION[2]	94.7	94.9	103.7	104.8	103.8	103.7	102.6	106.8	111.6	118.5
less CONSUMPTION[3]	79.6	82.7	87.2	95.7	97.2	101.9	108.3	110.4	114.2	115.8
equals ENDING INVENTORY	424.0	436.2	452.7	461.8	468.4	470.2	464.5	460.9	458.3	461.0
RELATIVE INVENTORY (years)[4]	4.6	4.5	4.4	4.4	4.3	4.2	4.1	3.9	3.8	3.6

[1]Nuexco estimate.
[2]This Report, Table 11
[3]This Report, Table 9.
[4]For each year, Relative Inventory equals the number of years of forward consumption which could be supplied by that year's Beginning Inventory.

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3. The estimated Free World inventory of approximately 400 million pounds U_3O_8 equivalent as of January 1, 1983 represents approximately five years of forward consumption. Although the inventory level will increase through 1988, *relative inventory* will decrease steadily to an average level of four years consumption. If Free World relative inventory is computed without including the US, it is substantially more than four years' consumption well into the next decade.

4. Table 13 shows US uranium consumption exceeding US uranium production in each year between 1983 and 1993. Inventory reductions and contracted imports will offset most of the US production shortfall, but a significant supply deficit is expected over the ten-year period. Cutbacks in inventory are likely to result in reductions to a level of 1.5 years' relative inventory for US utilities by the end of 1988. Based on Nuexco's survey of utility attitudes, the analysis assumes they will maintain a collective minimum of 1.5 years' forward requirements in inventory.

Methodology

Consumption, inventory levels, desired inventory levels and contracted supply are the basic factors that must be known to calculate unfilled demand. Market demand can be higher or lower than consumption, depending on users' inventory levels and policies. For example, market demand would fall short of consumption if uranium inventories were reduced in order to fill need which otherwise would appear as demand. Market demand can exceed consumption if buyers deficient in inventory plan their procurement strategies in order to enhance security of supply. Demand also can exceed consumption if buyer obligations to suppliers of fuel cycle services require earlier purchase of uranium than a reactor's operating schedule dictates.

Nuexco determines individual utilities' inventory levels by analyzing data from a wide range of sources, including the utilities, published documents, and contacts throughout the industry. Nuexco estimates desired inventory levels on the basis of historical trends and utilities' known attitudes.

Table 13

UNITED STATES URANIUM BALANCE[1]
(millions of pounds U_3O_8 equivalent)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
BEGINNING INVENTORY	134.4[2]	127.8	114.9	105.6	91.7	75.7	61.6	56.0	56.7	57.9
plus PRODUCTION[3]	16.3	12.2	15.3	17.1	17.2	18.2	18.3	20.9	22.4	22.3
less CONSUMPTION[4]	28.9	29.5	30.6	36.4	38.4	39.9	38.9	37.6	39.4	38.4
plus CONTRACTED NET IMPORTS[2]	6.0	4.4	6.0	5.4	5.4	4.6	4.5	4.5	4.0	3.8
plus UNFILLED DEMAND[5]	0	0	0	0	0	3.0	10.5	12.9	14.2	12.8
equals ENDING INVENTORY	127.8	114.9	105.6	91.7	75.7	61.6	56.0	56.7	57.9	58.4
RELATIVE INVENTORY (years)[6]	4.2	3.8	3.2	2.8	2.3	1.9	1.5	1.5	1.5	1.5

[1]Assuming US utilities maintain at least 1.5 years' relative inventory.
[2]Nuexco estimate.
[3]This Report, Table 11.
[4]This Report, Table 9.
[5]Derived value to satisfy ending inventory requirements for a minimum of 1.5 years' relative inventory.
[6]For each year, Relative Inventory equals the number of years of forward consumption which could be supplied by that year's Beginning Inventory.

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THE FEDERAL ENERGY REGULATORY COMMISSION

One of the most prominent characteristics of public utilities is that they operate at greatest efficiency as monopolies. In the absence of a competitive marketplace to restrain utility management, the USA has substituted government regulation. The stated purpose of government regulation is to provide reliable service for the consumer at reasonable rates and, in the case of investor-owned utilities, reasonable profits for the stockholders.

The energy regulatory structure in the USA reflects a division of powers between the individual states and the federal government, within which the most prominent energy regulating body is the Federal Energy Regulatory Commission (FERC). The five Commission members, one of whom is designated as Chairman, are appointed for four-year terms by the President, (with the advice and consent of the Senate). FERC is responsible for developing, managing, and directing energy regulatory programs and activities assigned to it by statute, executive order, or by the Energy Secretary. An independent organization within DOE, FERC is not subject to the supervision or direction of any other DOE official.

FERC is a direct descendent of the former Federal Power Commission (FPC). The FPC originated with the passage of the Federal Water Power Act of 1920. At that time, the FPC's power was limited to licensing the construction of dams across navigable waters. The inability of the Interstate Commerce Commission or the FPC adequately to regulate electric and gas utilities led to the passage of the Federal Power Act in 1935. That act gave the FPC jurisdiction over securities, accounts, and interstate rates and service of all interstate electric utilities, and instructed the FPC to devise plans for the interconnection and coordination of electric facilities. The FPC's jurisdiction was extended to the regulation of natural gas in interstate commerce by the Natural Gas Act of 1938.

On September 30, 1977, Congress passed the Department of Energy Organization Act. Among other things, the DOE Act created FERC and transferred to it most of the FPC's interstate regulatory authority over the electric power and natural gas industries. In addition, FERC was given the authority to determine oil pipeline transportation rates and to set the value of oil pipelines for ratemaking purposes, and it was given a combination of review functions over DOE actions.

In October 1978, passage of the National Energy Act gave FERC the authority to regulate producer sales of natural gas in intrastate commerce. FERC established uniform ceiling prices for each of several categories of natural gas, and those prices now apply to all gas sales nationwide.

With respect to the electric power industry, FERC establishes and enforces rates for the transmission and sale for resale of electric power in interstate commerce. It regulates permanent interconnections of electric utilities and ensures the adequate supply of interstate electric power service. FERC also regulates the issuance of all regulated electric utility securities as well as the mergers of regulated electric utilities. Finally, FERC established and enforces the Uniform System of Accounts, a body of accounting rules and procedures for the electric utility industry. Nuclear fuel accounts include:

1. 120.1—Nuclear fuel in process of refinement, conversion, enrichment and fabrication;
2. 120.2—Nuclear fuel materials and assemblies (stock account);
3. 120.3—Nuclear fuel assemblies in reactor;
4. 120.4—Spent nuclear fuel;
5. 120.5—Accumulated provision for amortization of nuclear fuel assemblies.

The techniques for treatment of nuclear fuel items in these accounts determine whether such items will accrue AFUDC (Allowance for Funds Used During Construction), or will be included in a utility's rate base, or will be held as non-revenue-producing inventory assets.

The **Office of the Chief Accountant** within FERC is responsible for the Uniform System of Accounts and for related reporting requirements, accounting rules and procedures, securities issuances, and audits of companies under federal jurisdiction. Reporting to the Chief Accountant are the Division of Accounting Systems and the Division of Audits. Nine other major offices comprise the internal structure of the agency.

The **Executive Director** is responsible for exercising executive and administrative authority delegated by the Commission member designated as Chairman, and supervising the regulatory functions of FERC. The major divisions within the Office of Executive Director are the Division of Budget and Administrative Liaison with the DOE, the Division of Planning and Evaluation, the Office of Public Information and the FERC Regional Offices.

The **Office of the General Counsel** is responsible for the conduct of all FERC litigation, the review of all FERC documents, the management and promulgation of standards of conduct, and all legislative and legal matters.

The **Office of Administrative Law Judges** is responsible for the conduct of all "on the record" hearings and such other hearings as directed by FERC.

The **Office of the Secretary** acts as the point of contact between the Commission and all those having business before it. The Office of the Secretary receives and distrib-

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utes pleadings filed with FERC, sets FERC's meeting agenda, attends meetings and records votes, and performs FERC's records management functions and regulatory support functions.

The **Office of Regulatory Analysis** provides policy advice and technical assistance to the Commission and the Office of Opinions and Reviews. The Office of Regulatory Analysis has five divisions: Finance, Economics, Analysis and Policy Development, Technology, and Environmental Advisors.

The **Office of Electric Power Regulation** is responsible for all technical matters involving electric utilities, except for those functions delegated to the Office of Regulatory Analysis. This Office is comprised of the following divisions: Rates and Corporate Regulation, Licensed Projects, Interconnections and Systems Analysis, and River Basins.

The **Office of Opinions and Reviews** is responsible for the analysis of administrative hearing records and other contested actions before FERC. This Office also reviews exceptions to initial decisions issued by Administrative Law Judges and will prepare opinions and orders for FERC.

The **Office of Pipeline and Producer Regulation** provides technical advice and assistance to rate-making bodies on the transportation and sale of natural gas and oil by pipeline, the issuance of certificates of public convenience and necessity for pipelines and producers, and the establishment and enforcement of gas curtailment provisions. This Office is made up of eight divisions, including Curtailment and Pipeline Systems Analysis, Pipeline Rates and Tariffs, Pipeline Cost Valuation, Pipeline Certificates, Producer Rates, Producer Certificates, Reserve Evaluations, and Compliance.

The **Office of Enforcement** is responsible for administrative proceedings that ensure enforcement of statutes and FERC rules, orders and regulations.

FERC performs its regulatory functions in two ways; rulemaking and adjudication. In the case of rulemaking, FERC may propose a general rule or a change in its regulations. However, it must issue a notice of the proposed rule and a request for comments in the Federal Register, publishing any final decision along with the comments it receives. Alternately, FERC may consider on a case-by-case basis, applications submitted by the companies it regulates. Objectionable proposals must be submitted to a hearing presided over by one of the agency's administrative law judges. A decision by such a judge may be adopted, modified, or reversed by the Commission. Any decision may be appealed to the US Court of Appeals and ultimately to the US Supreme Court.

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THE LODEVE URANIUM PROJECT

Introduction

The uranium occurrences at Lodeve represent one of the largest and most important discoveries in France. At least two important deposits had been discovered by 1957 following nearly four years of exploration in the Lodeve district of Herault. The original resource estimate for the deposits was approximately 48 million pounds U_3O_8, representing at the time 30 to 35 percent of reasonably assured resources recoverable at US$30.00 per pound in France. Additional discoveries were made as exploration progressed. Presently two deposits are being mined, two are in the final stages of evaluation, and several more discoveries have been recorded and are in various stages of evaluation. Annual production of uranium concentrate at Lodeve exceeds 2.3 million pounds U_3O_8, about 30 percent of domestic French production. Present ore reserves for the Lodeve district are approximately 42 million pounds U_3O_8.

The French uranium exploration program was initiated in 1946 when the government created the Commission for Atomic Energy (CEA). The exploration effort began in the granitic rocks of the Massif Central where radioactive occurrences were known from historical exploration and from mining operations for radium and other minerals. The sedimentary basins surrounding the Massif Central also were considered potential for uranium deposits due to the geologic relationship of granitic and volcanic source rock, and associated mineralization.

The CEA exploration effort experienced early success by making important discoveries in the granite environment at La Crouzille in 1948. A number of discoveries had been made by 1954, primarily around the eastern and western limits of the Massif Central. Exploration of the sedimentary basins began about that time, resulting in the discovery at Lodeve in 1957.

More than 70 uranium occurrences have been discovered throughout France by the CEA and industrial groups who had initiated separate exploration programs in the early 1950s. A number of important discoveries were made and mine development was soon undertaken on the more favorable deposits. Lodeve is the newest production center in France. Presently there are five other mine and mill facilities producing uranium concentrates. Nuexco estimates that 1983 production will total about eight million pounds U_3O_8, of which approximately 2.4 million pounds will be produced at Lodeve.

The Lodeve mine is operated by Compagnie Generale des Matieres Nucleaires (COGEMA) which is a subsidiary of CEA. The processing plant is operated by Societe Industrielle des Minerais de l'Ouest (SIMO), a subsidiary company to COGEMA. SIMO designed the processing plant, supervised construction and is the operator. The two companies operate under the same relationship at the Bessines and Ecarpiere mine and mill production centers located in central and northwestern France.

CEA obtained the right to exploit known ore deposits at Lodeve in 1966; however, it was April 1979 before the license to build a processing plant was granted, and September 1980 when a production license was granted. The concession area is designated as area A on Figure 4. Four important ore deposits are located on the Lodeve concession. COGEMA has exploration permits on the Merifons and Graissessac districts, designated as areas B and C on Figure 4.

Ore Deposits

Two ore deposits presently are being mined at Lodeve. The ore occurs in host rock of carbonaceous sandstone, mudstone and dolomite. The largest, designated the Mas Lavayre deposit, was estimated to contain approximately 36 million pounds U_3O_8 (14,000 metric tons U) at an ore grade of 0.20 to 0.50 percent U_3O_8. The depth to the upper ore zone is about 130 meters; the base is about 320 meters. The deposit is confined primarily between two major fault systems (the Rivieral on the down-dip side,

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and the St. Julien on the up-dip side). The faults serve as a principal geologic control for mineralization. The principal uranium minerals are pitchblende and coffinite closely associated with iron sulfides, molybdenum and organic bituminous material. Orebody dimensions are roughly 1500 meters parallel to the faulting; the width varies from 200 to 600 meters between faults. The deposit is being mined by underground methods.

The second important deposit is known as the Mas d'Alary. It and the smaller Treviels deposit, which is an extension on the same mineral trend, contain approximately 11.7 million pounds U_3O_8 (4,500 metric tons U) at an average ore grade of 0.17 percent U_3O_8. Uranium mineralization occurs in a sandstone-mudstone formation about 800 meters north of the Mas Lavayre deposit. The ore has accumulated as lenticular bodies in the stratified sediments and is confined laterally by paralleling faults. The South fault is on the down-dip side; the Central fault is on the up-dip side. Ore was discovered near the surface and to a depth of about 65 meters. The Mas d'Alary is being mined by open pit methods; the Treviels is scheduled for open pit mining in the near future.

Mining

The ore reserves at Lodeve were well defined by 1966. COGEMA completed a project feasibility study and applied to the local government administrator for permission to mine and mill ore from the Mas Lavayre and Mas d'Alary deposits. Permission was granted in September 1966 for mine development. Underground development at Mas Lavayre began in 1975; surface mining began at Mas d'Alary in 1978.

Two declines provide access to the ore in the Mas Lavayre deposit. The main entryway is decline "A" which is designed to handle all vehicle traffic. It descends at a grade of 17 percent and is 1900 meters in length. It spirals downward at a 45° turn 330 meters from the portal,

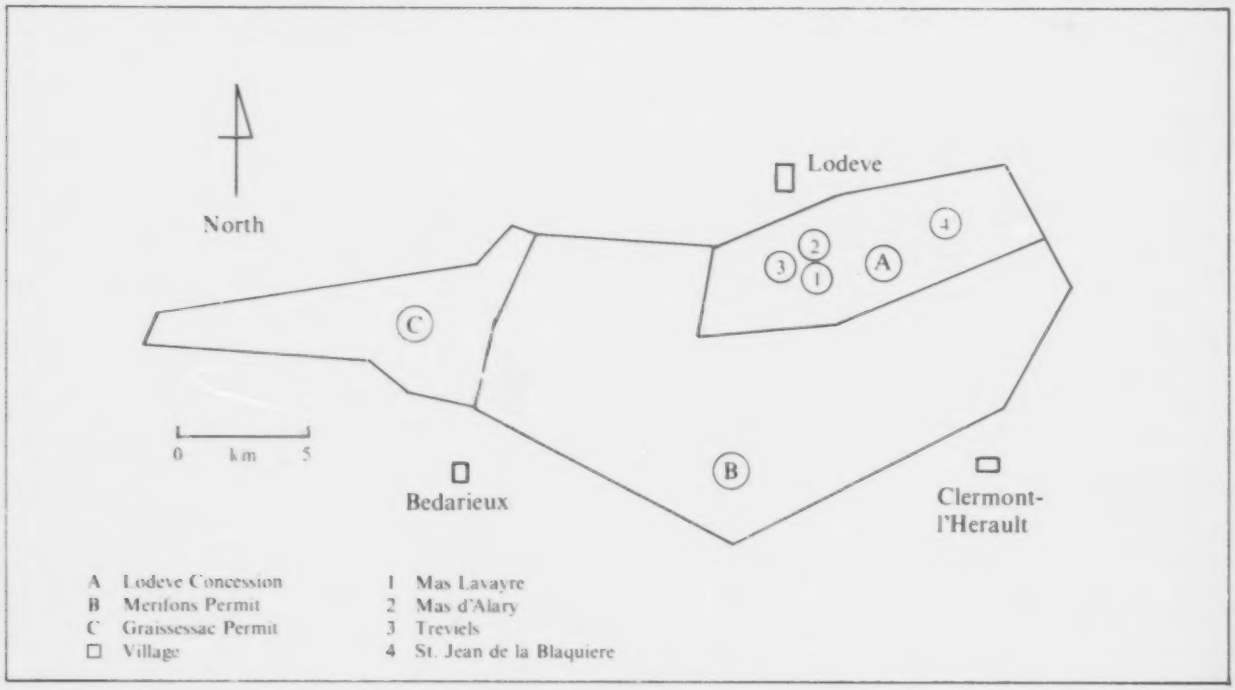

Figure 4

Outline of Lodeve Project Area, Herault Province, Southern France

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followed by two U-turns to the base of the ore zone. The "A" decline is located entirely within the footwall of the Rivieral fault, allowing complete access to the entire ore deposit. Five drifts have been driven at various levels off the decline and into the ore zone. Mining is conducted through the three lower drifts only.

Decline "B" is the second entry into the deposit. It is designed to remove ore and waste from the mine by a conveyor system. It has a straight descent of 25 percent from surface to the lowest part of the mine and has an overall length of 1300 meters.

Ore passes connect each working level. Mining ore (and waste) is dropped through an ore pass to a crusher station located at the bottom level. All rock is crushed and fed onto the conveyor belt, traveling to the surface at a rated capacity of 250 tonnes per hour.

Ore is extracted by driving access drifts through the length of an ore zone. Cross cuts are driven on a spacing of 5 to 10 meters at right angles to the access drifts through the minable ore zone. The pillars between cross cuts are extracted at a rate coordinated to back-filling procedures. Upon completion of an ore extraction sequence, the mined-out area is immediately back-filled. Waste rock is crushed and mixed with cement, forming a slurry which is pumped into the mined-out space. The mining-backfilling technique permits safe and total extraction of each ore zone.

The open pit mine is being developed by conventional strip mining techniques. The overburden is blasted and removed; benches are developed as required to maintain pit walls at a slope of 1:1 over 5 meters. Exposed and broken ore is graded by a sampler using a gamma ray probe. The sampler directs mining of ore to maintain proper grade control. As one section of the deposit is mined out, the pit is back-filled with mill tailings.

Removal of overburden from the Mas d'Alary deposit began on the shallowest and smaller portion of the ore zone. The pit is developing southward to include the deeper ore. Approximately 13 million tonnes overburden had been removed by the end of 1982; mined ore totalled almost 1.5 million pounds U_3O_8. Another seven to nine million tonnes overburden will be removed to gain full access to remaining ore. The pit will eventually be extended northward to include the mining of near-surface ore extensions including the Traviels and Les Mares deposits. New pits will be developed to mine the more favorable satellite deposits. Figure 5 is a recent photograph of the Mas de'Alary open pit.

Ore Processing

The uranium ores in the Lodeve district occur primarily in carbonaceous sandstone and dolomite host rock. Sulfides containing up to 1 percent sulfur and small quantities of molybdenum occur in close association with uranium and organic material (humic acid and bitumen). The mineral combination presented difficult metallurgical problems. SIMO developed an alkaline leach process to obtain maximum recovery of uranium from the ores. (All other recovery systems in France utilize an acid leach process.)

The alkaline process includes a pre-leach period of three hours at a temperature of 140° C in an oxygen-rich environment. Sodium carbonate and siderite ($FeCO_3$) are added to the resulting pulp as it passes into a secondary leach cycle of 6 hours at the same temperature. The uranium, molybdenum and organics remain in solution.

The uranium is precipitated by the addition of lime. The organic material follows the uranium and is eliminated by roasting at a temperature of 650° C. The molybdenum remains in the primary effluent and is concentrated by evaporation; the concentrate is treated to recover the molybdenum and to eliminate any remaining traces of organics. The final stage of precipitation and concentration of the uranium is accomplished by the addition of milk of magnesia to form a product of magnesium uranate which contains at least 70 percent U_3O_8. Figure 6 shows the layout of the processing plant.

Geology

The regional geologic setting of the uranium district is represented by a series of structural basins situated on the southern limits of the Massif Central. The Massif Central is a broad mountainous highland region that occupies much of central France. It consists basically of a granitic core with associated schists and gneisses formed by metamorphism of intruded sediments. The highlands of the Massif Central developed during the Hercynian Orogeny which has been age dated at 325 to 350 million years.

Tectonic action was renewed during the Alpine Orogeny of Late Cretaceous and Early Tertiary time (estimated at 135 to 65 million years). Structural development of the Lodeve province was rejuvenated. Tectonic activity, including regional faulting and subsidence, preserved the east-west trending basin structures; but more importantly, it preserved intact the lower series of Permian sedimentation. All uranium at Lodeve is found in Lower Permian rocks.

The Permian Formation is divided into two main units. The upper unit is the Saxionian which is approximately 1400 meters thick. It consists of alternating fine-grained sediments that are only occasionally mineralized near the base. Only one small ore deposit has been discovered in the Saxionian, but widely scattered occurrences of low-grade mineralization are not uncommon.

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The lower unit is the Autunian; it is the principal uranium-bearing sequence. The basal section of the Autunian is a conglomerate which is in unconformable contact with older Paleozoic and Precambrian rocks. Overlying the conglomerate is a 600-meter-thick sequence of stratified (one meter or less thick) alternating beds of fine-grained carbonaceous sandstones and mudstones, and bituminous dolomites and limestones. Gray zones in the predominantly red Permian beds outline alteration channels created by mineral-rich solution activity.

Mineralization

The main controls for mineral deposition appear to be a combination of tectonic and stratigraphic features in an altered zone within a Permian Basin. Uranium and associated minerals have accumulated within the alteration channels of stratified beds, primarily in close relationship to the increasing percentage of carbonate and bituminous matter. The alteration pattern reflects a strong east-west trend associated with regional tectonics. The most important mineralization is located along the flanks of channels and at abrupt stratigraphic changes where oxidation and reduction appear to be more intense. Usually these zones show a high degree of fracturing and brecciation related to tectonic activity.

The uranium minerals pitchblende and coffinite, plus the miscellaneous mineral assemblage, are concentrated on the fractured surfaces of broken and altered rock. In addition, mineralization has concentrated in the more permeable sandstone units within the gray zones to form lenticular ore deposits, usually in close proximity with structurally controlled ore. Remobilization of uranium has occurred along faults and fracture zones, sometimes resulting in thicker and higher grade deposits.

The source of uranium mineralization is probably volcanogenic. Widespread volcanic activity erupted throughout the Massif Central during this period. Mineral-rich solutions formed during the weathering process of volcanics and granites of the Massif Central. The solutions migrated downward into Permian rocks. Stratigraphic and tectonic conditions controlled the precipitation of uranium and molybdenum in the presence of a bituminous-rich (reducing) environment.

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Figure 5

Aerial View of the Mas d'Alary Open Pit and Processing Plant at Lodeve

Figure 6

Uranium processing plant at Lodeve. (1) Ore delivery from underground mine; (2) crushing circuit; (3) pressure leach circuit; (4) ion exchange and precipitation circuits; (5) administrative offices

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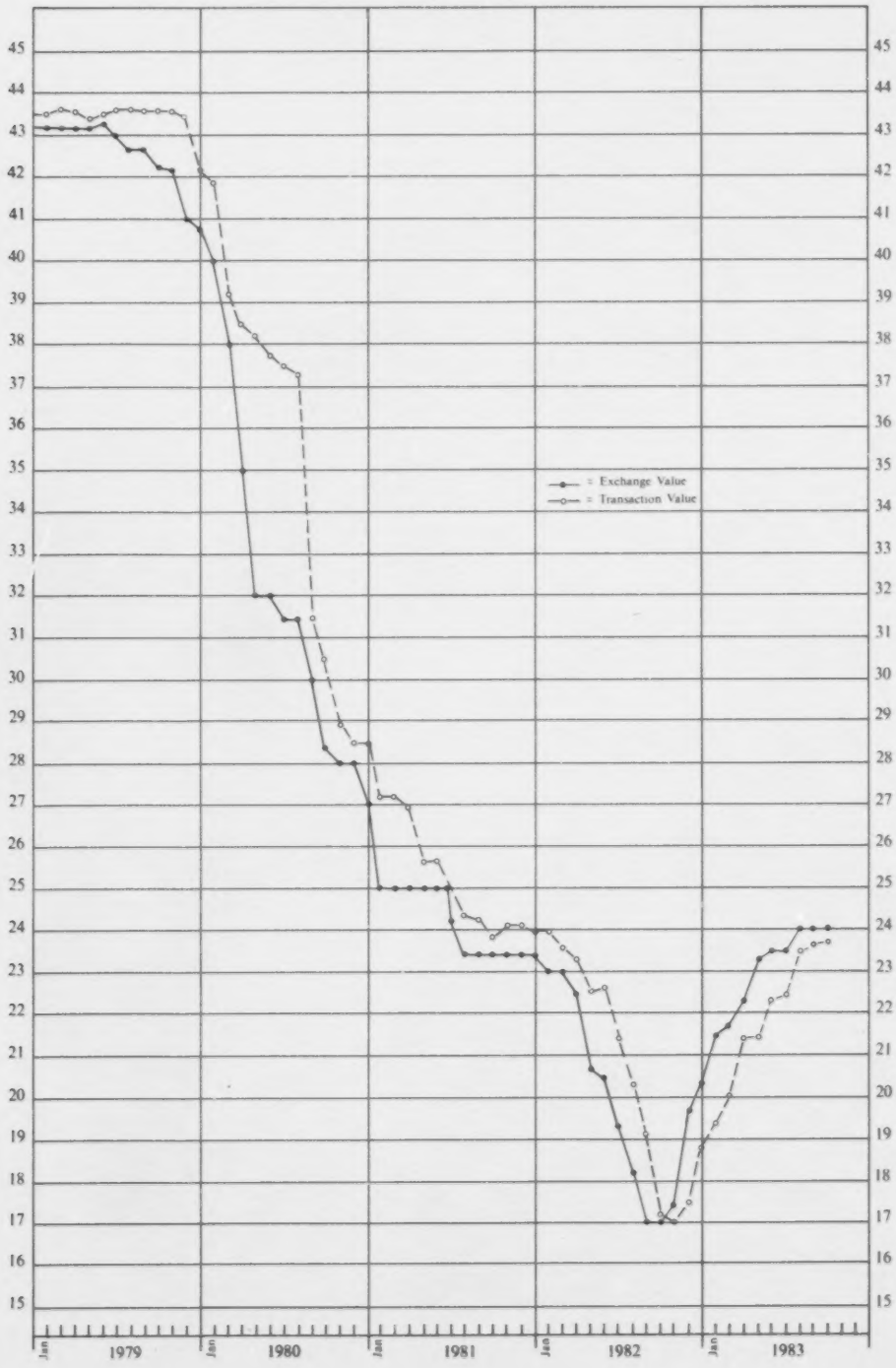
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1979
Determined as of the last day of the month indicated



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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	**24.00**			

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	**23.65**			

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	**1.00**			

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage Earners, Weekly Rates (Year 1976 = 100.0)[2]
Annual Avg. 1972[3]	105.6	71.26
Annual Avg. 1973[3]	124.4	78.96
Annual Avg. 1974[3]	141.9	108.07
Annual Avg. 1975[3]	150.4	132.55
Annual Avg. 1976[3]	168.4	160.93
Annual Avg. 1977[3]	192.0	179.03
Annual Avg. 1978[3]	198.5	190.04
Annual Avg. 1979	248.8	196.34
Annual Avg. 1980	321.8	218.00
Annual Avg. 1981	355.3	237.34
Annual Avg. 1982	368.5	174.88
May 1982	367.6	171.9
Jun 1982	367.8	173.2
Jul 1982	370.0	177.2
Aug 1982	372.5R	178.2
Sep 1982	375.2	178.4
Oct 1982	378.4	178.4
Nov 1982	375.8	178.5
Dec 1982	375.0	179.5
Jan 1983	386.9	179.6
Feb 1983	388.6	179.5
Mar 1983	398.7	179.4
Apr 1983	410.2	179.7
May 1983	417.1	179.8
Jun 1983	—	179.9
Jul 1983	—	179.5P

P = Preliminary R = Revised since last month

[1]Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.
[2]Australian Bureau of Statistics, Canberra: "Award Rates of Pay Indexes, Australia" (Catalogue No. 6312.0), Table 8. Figures for the latest fourteen months shown are subject to revision.
[3]Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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CANADA

	Industry Selling Price Index: Manufacturing (D 500000)[1] [2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[4] [5]				
		Metal Mining, including Milling (SIC 050-099)[3]	Primary Metal Industries, non-ferrous (SIC 296-298)[6] (SIC 296)		(SIC 298)	Chemicals and Chemical Products (SIC 372-379)[7]
Annual Avg. 1979	217.9	9.66	—	7.35	—	7.67
Annual Avg. 1980	247.2	10.80	—	8.05	—	8.50
Annual Avg. 1981	288.7	12.23	—	9.03	—	9.53
Annual Avg. 1982	288.8	13.92	—	9.98	—	10.63
Jun 1982	289.7	13.83	—	9.92	—	10.69
Jul 1982	290.3	14.02	—	10.05	—	10.73
Aug 1982	290.3	14.23	—	10.03	—	10.80
Sep 1982	292.4	14.01	—	10.18	—	10.73
Oct 1982	292.1	13.89	—	10.18	—	10.86
Nov 1982	291.3	14.28	—	10.43	—	10.90
Dec 1982	292.3	14.32	—	10.55	—	11.06
Jan 1983	292.7R	14.35	—	10.72	—	11.06
Feb 1983	293.5	14.28	—	10.74	—	11.06
Mar 1983	295.2	14.48	—	10.93	—	11.21
Apr 1983	297.1	14.13	11.57	—	10.10	11.02R
May 1983	298.5	14.10R	11.39	—	9.82	10.97
Jun 1983	299.2	14.07R	11.33R	—	9.84R	11.05P
Jul 1983	300.1	13.91P	11.65	—	10.29P	11.04P
Aug 1983	300.7	—	—	—	—	—

P = Preliminary R = Revised since last month

[1]Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

[2]Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

[3]The wage earner series in Nuexco reports prior to March 1983 was Metals (SIC 050-059).

[4]Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

[5]Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

[6]Beginning with the April 1983 figure, Primary Metal Industries, non-ferrous is split into SIC 296 and SIC 298.

[7]Chemical and Chemical Products prior to April 1983 was SIC 370-379. The new series is from a new survey which includes all companies and is based on a 1970 classification. The old survey included companies of 20 employees or more.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 160, except where otherwise indicated)	Producer[5] Price Index All Groups (1975 = 100)	Total Employment in Mining and Quarrying (Code 35)[7]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[7]
Annual Avg. 1972[3]	8.79	113.3[4]	63.9	623,067	443,933
Annual Avg. 1973[3]	10.51	124.1[4]	72.3	684,743	572,133
Annual Avg. 1974[3]	13.18	138.5[4]	85.3	674,140	761,596
Annual Avg. 1975[3]	16.71	157.2[4]	100.0	639,473	1,003,617
Annual Avg. 1976[3]	19.30	174.7[4]	115.1	671,240	1,212,983
Annual Avg. 1977[3,6]	23.87	194.4[4]	130.0	712,006	1,420,670
Annual Avg. 1978[3,6]	27.14	137.2	142.7	664,571	1,537,169
Annual Avg. 1979[3,6]	30.18	155.3	164.5	692,209	1,830,632
Annual Avg. 1980[6]	35.53	176.7	192.1	714,379	2,279,615
Annual Avg. 1981	41.89	206.5	218.3	728,506	2,820,505
Annual Avg. 1982	47.25	233.5	248.7	707,552	3,246,071
Mar 1982	45.49	225.2	237.4	725,700	262,210
Apr 1982	—	228.9	241.9	707,502	252,562
May 1982	—	230.3	244.8	715,162	258,770
Jun 1982	45.77	232.1	246.7	707,552	261,361
Jul 1982	—	234.1	249.4	702,141	283,248
Aug 1982	—	236.8	253.4	705,562	276,730
Sep 1982	48.04	241.0	255.0	704,344	282,782
Oct 1982	—	243.9	260.1	701,316	285,328
Nov 1982	—	245.4	262.5	707,966	287,699
Dec 1982	49.62	246.2	263.0	683,982	288,019
Jan 1983	—	249.0	264.9	688,030	289,075
Feb 1983	—	253.1	267.4	697,089	281,413
Mar 1983	50.35	255.9	269.1	695,976	290,586
Apr 1983	—	257.8	270.9	697,158	286,708
May 1983	—	259.7	274.1	701,712	295,701
Jun 1983	50.51	260.8	273.1	706,933	300,177
Jul 1983	—	262.5	273.7	—	—
Aug 1983	—	265.6	—	—	—

[1]Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly. The tonnage-weight index of average working costs per metric ton of gold ore milled for 1983 is as follows. (Base: March quarter 1982 = 100). See Nuexco report #178 page 24 for the tonnage-weighted index for 1982. Description and calculation of the index is on page 16 of Nuexco report #178.

1983: January-March	111.2
April-June	111.9

[2]Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."

[3]Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Nuexco Report 140.

[4]April 1970 = 100.00.

[5]Previously known as the WHOLESALE PRICE INDEX, now the PRODUCER PRICE INDEX. The computation remains the same.

[6]Historical data for Codes 35 and 40 1977-1980 appear on page 28 of Nuexco Report 157.

[7]Bulletin of Statistics, Department of Statistics, Pretoria.

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GOVERNMENT STATISTICS

UNITED STATES

	Producer Price Index— Industrial Commodities (1967 = 100)[1]	Producer Price Index— All Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
					Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
Annual Avg. 1972[5]	117.9	119.1	125.3	100.00	4.56	4.59	4.26	3.71
Annual Avg. 1973[5]	125.9	134.7	133.1	105.75	4.84	4.98	4.51	3.91
Annual Avg. 1974[5]	153.8	160.1	147.7	115.08	5.44	5.63	4.88	4.21
Annual Avg. 1975[5]	171.5	174.9	161.2	125.79	6.13	6.24	5.39	4.64
Annual Avg. 1976[5]	182.4	183.0	170.5	132.34	6.76	6.87	5.91	4.96
Annual Avg. 1977[5]	195.1	194.2	181.5	140.05	7.28	7.67	6.43	5.39
Annual Avg. 1978[5]	209.4	209.3	195.4	150.42	8.23	8.56	7.02	5.82
Annual Avg. 1979[5]	236.5	235.6	217.4	163.42	9.27	9.50	7.60	6.32
Annual Avg. 1980[5]	274.8	268.8	246.8	178.64	10.26	10.63	8.30	6.94
Annual Avg. 1981	304.1	293.4	272.4	195.51	11.55	11.98	9.12	7.62
Annual Avg. 1982	312.3	299.3	289.1	207.15	12.33	12.94	9.96	8.21
Aug 1982	313.2	300.2	292.8	—	12.29	13.01	10.01	8.30
Sep 1982	312.7	299.3	293.3	208.51	12.53	13.51	10.19	8.37
Oct 1982	314.3	299.8	294.1	—	12.51	13.26	10.22	8.41
Nov 1982	315.0	300.3	293.6	—	12.53	13.22	10.26	8.45
Dec 1982	315.2	300.7	292.4	210.00	12.53	13.05	10.32	8.51
Jan 1983	313.9	299.9	293.1	—	12.63	13.33	10.34	8.53
Feb 1983	313.9	300.9	293.2	—	12.66	13.29	10.41	8.56
Mar 1983	313.5	300.6	293.4	212.83	12.48	13.35	10.39	8.60
Apr 1983	312.4R	300.6R	295.5	—	12.67	13.34	10.43	8.60
May 1983	313.8	301.7	297.1	—	12.55	13.62	10.50	8.60
Jun 1983	315.4	302.5	298.1	214.55R	12.66R	13.38R	10.52R	8.63R
Jul 1983	316.6	303.2	299.3	—	12.70P	13.54P	10.56R	8.68R
Aug 1983	317.5P	304.9P	300.3P	—	—	—	10.59P	8.59P

P = Preliminary R = Revised since last month

[1]US Bureau of Labor Statistics, Washington, D.C.: "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

[2]US Bureau of Labor Statistics, Washington, D.C.: Consumer Price Index for All Urban Consumers, US City Average, All Items.

[3]US Department of Commerce, Washington, D.C.: Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table 7.1. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

[4]US Bureau of Labor Statistics, Washington, D.C.: "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for 1977-1978 are adjusted to the March 1979 benchmark. Data for January 1979 and beyond are adjusted to the March 1980 benchmark.

[5]Monthly data 1970-1978 for Producer Price Index-Industrial Commodities, Consumer Price Index, and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.
Monthly data 1977-1978 for Employment and Earnings SIC Codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.
Monthly data 1970-1978 for Employment and Earnings SIC Code 36 appear on page 23 of Nuexco Report 154.
Monthly data 1979-1980 for Employment and Earnings, Revised Establishment Data, all listed codes, appear on page 22 of Nuexco Report 158.
Monthly data 1977-1980 for Producer Price Index-All Commodities, appear on page 21 of Nuexco Report 158.

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MEGATRENDS IN NUCLEAR FUEL: APPROACHING A NEW ERA

By

J. R. Wolcott
Chairman
Nuexco

Presented To:

Fourth Pacific Basin Nuclear Conference

Vancouver, British Columbia
September 12, 1983

MEGATRENDS IN NUCLEAR FUEL: APPROACHING A NEW ERA

By: J. R. Wolcott
Chairman
Nuexco

Introduction

The nuclear power industry as a whole has had a stormy decade, and the fuel side has been jolted by shockwaves. Prices rose and fell sharply; supply and demand became far out of balance; mines dependent on high prices suffered closures, while new high-grade deposits were developed. The United States reduced production by two-thirds within a few years. The epicenter of Canadian production moved west.

Although the problems of the past decade have not fully receded, there are signs that much of the shock has been absorbed and that the next decade will be calm by comparison. Within four or five years the uranium industry may achieve improved and welcome stability. Today the excess of production over consumption is not so huge as it was in recent years; prices are improving and market changes are not violent. The worst is probably behind us.

I do not mean to suggest the end of uncertainties. But the controlling variables are stabilizing. Estimates of future consumption and production have a much more solid basis today than they had ten years ago.

Consumption

I expect actual consumption in 1990 to fall within 10% of our current Nuexco forecasts. That statement would be ridiculous if the variables confronting a forecaster today were as uncertain as they were 10 years ago.

A consumption forecast depends mainly on the projection of fuel needs for three categories: reactors in operation; reactors under construction; and anticipated orders. A twenty-year forecast prepared in 1973 depended overwhelmingly on anticipated orders, less on projects in progress, and least on plants in operation. The largest component, anticipated orders, was the most speculative. Least speculative was the smallest component, plants in operation.

Today the situation is completely reversed. The largest component is the least speculative, plants in operation. We know a great deal about the needs and timing of units that are operating or are approaching completion. The smallest component to consider today is anticipated orders: there will probably be none in the United States significantly affecting uranium consumption by the year 2000. Outside the US the number of orders requiring uranium before the year 2000 will be on the order of 35 to 40. Uranium to service those units will approximate 15 million pounds U_3O_8 per year, some 15% of current production levels.

The modestly predictable conditions of today will steadily become more predictable as new plants go into operation. For example, the US has 76 units in operation and another 65 under construction. More than half of those under construction are more than 50% complete. The fact that approximately 120 units will be in operation by 1990 is the single overriding factor in any US consumption forecast.

Of course, operating plants have technical variables that must be considered in any consumption assessment: capacity factor, availability, tails assays, and technical improvements in fabrication all have influence; but their importance is small when compared to plant cancellations, schedule delays, and electrical load growth variations.

Production

A decade ago the uranium production industry was driven by speculation that nuclear fuel demand was on the verge of long-term rapid growth. Utilities prompted this assumption by ordering uranium and stockpiling inventory for plants which in many cases failed to materialize. The US government artificially promoted domestic production with an import embargo and with enrichment policies that forced feed deliveries in advance of true need. New and marginally competitive producers saturated the market. Even though US reactor orders virtually ceased in 1974, US yellowcake production continued to grow. A peak of 43 million pounds in 1980 was reached, six years after the pace of new orders had almost stopped and the epidemic of plant cancellations had begun.

Nevertheless, the precipitous decline was to startle many users and producers. The lower demand became fully apparent only in the aftermath of the TMI accident and the worldwide recession caused by oil prices. The virtual standstill of the nuclear power industry made the supply excess obvious.

Mineral economics had a major impact on the production industry. Discoveries in Western Canada made available ore grades 10 to 20 times higher than those found in most active US mines. Australian deposits were also several times the average US ore grade. As the US import

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embargo was phased out, a large portion of the previously protected US industry came into competition with strongly-based foreign producers.

The present world production situation may be described as follows:

First, the United States has passed through a period during which much uneconomic and marginal production capacity was swept away. The 1980 US output of 43 million pounds was twice the domestic consumption rate. Unable to compete with low-cost producers in the export market, US producers have cut back to a rate of 16 million pounds per year, which is about half the present domestic consumption rate. Most of that which remains has been economically tested. The current annual level will probably decrease slightly next year, but then recover to a higher level during the remainder of the decade. Utility preference for domestic supply will lend support to US producers.

Second, Western Canada is developing its high-grade orebodies in Saskatchewan on a scale that will be difficult to match. The projected annual production rate there of 20 million pounds stands firm like the "Rock of Gibraltar" of the uranium world.

Eastern Canada is producing more than 10 million pounds per year, but is more vulnerable to competition. While long-term contracts have a stabilizing influence, pressure is building to reduce quantities and prices. Eastern Canada does not have the strong underpinning of low-cost resources that Western Canada enjoys.

Third, South Africa will continue to produce over 15 million pounds per year, 15% of world production. The low cost of uranium-gold by-product or co-product operations places South Africa in an enviable competitive position.

Fourth, Namibia produces 10 million pounds per year, 10% of world output, from the giant open-pit Rossing Mine. Economics are favorable, although perhaps not as favorable as for some mines with higher-grade ore. Namibia's economy has a great need for foreign exchange. Social and political disruptions will not necessarily interfere with the export of uranium.

Fifth, Gabon and Niger provide approximately 10% of world production. Costs are less favorable than those of other regions, production is largely captive to the French nuclear power porgram, and substantial cutbacks should be expected

Sixth, ERA and Queensland Mines in Australia, together exporting 10% of world production, possess a combination of ore grades and investment that appears to be economically secure.

Total annual production from the most economically secure regions—Western Canada, South Africa and Australia—is about 45 million pounds, or approximately 45% of world production. The group at the next level—Namibia, the United States and Eastern Canada—adds another 35 million pounds, or 35% of world production. These two groups with a high-to-moderate degree of economic security provide 80% of annual production. They have an excellent chance of providing that percentage well into the next decade.

Governments

Virtually every decision by users and producers involves an estimate of what governments have done or will do. At present, major government concerns are: (1) Australian restraints on development; (2) the potential for a US import embargo; (3) reactions to South African apartheid; and (4) Canadian marketing policies, such as the upgrading requirement.

Australia is puzzling. The government's position reminds me of Winston Churchill's description of Russia in October of 1939—"a riddle wrapped in a mystery inside an enigma." The forces inside the Australian government appear to be more complex than we distant outsiders can readily comprehend.

Nevertheless, I believe that economic pragmatism will ultimately prevail. While short-term Australian expansion appears unlikely, a termination of that production already underway also appears unlikely. As it will be difficult to attract new long-term customers or foreign investment until confidence in government policy is reestablished, production will probably remain at or near the present level for a number of years.

The probability of an effective US import embargo is low. Special interests continue to promote the idea; however, an embargo on foreign uranium probably would not make it through the legislative process on its own merits. Nonetheless, an embargo *could* be enacted as an amendment to more prized legislation. Granted that element of uncertainty, I still believe a really meaningful embargo will not pass the Congress.

South Africa's apartheid problem has no parallel for political and social complexity: criticism is abundant and practical solutions are scarce. The variety of group and tribal interests within South Africa places a special premium on economic continuity. The likelihood that export of gold and uranium will be interrupted is small.

The Canadian government favors uranium production

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and exports and has contributed to the success of domestic producers. A potentially prohibitive policy of the government is the requirement that all domestic production be upgraded to UF_6 in Canada, but thus far that policy appears to have damaged business little. In any case, government policy probably will not cause any long-term interruption of exports.

Based on this general appraisal of politics in uranium producing nations, I do not see on the horizon much likelihood of government-caused alterations of the world's uranium megatrends.

Balancing Consumption and Production

I can paint, as I just have, a picture of emerging consumption stability on the one hand, and of developing production stability on the other, but other conditions are necessary for the achievement of dynamic market equilibrium. The most important conditions are: (1) adequate information, (2) a secondary market, (3) production buffers, and (4) calm psychology.

Information—A decade ago, market dynamics were inadequately understood. The flow of information between buyers and sellers was sparse, and romantic expectations had more influence than did objective analysis. Nowadays, utilities will not contract for large quantities of unneeded supplies; an inflated enrichment contract demand no longer stimulates excess uranium production; and the role of governments is fully appreciated.

Secondary Market—A secondary market has always existed, but its use has usually lagged the need. Consequently, imbalances developed to a point where redistributions produced severe jolts. More recently, the secondary market has been relieving existing stresses more rapidly than new stresses are developing, so that the overall market imbalance is subsiding.

Production Buffers—As the various forces pushed production to its limits throughout the 1970s, small demand increases unduly accelerated price. That is no longer the case. South Africa could absorb another five million pounds of demand quickly, and Canada could do likewise. An increase of $10 to $15 in price could elicit another 10 million pounds of production from the US. Today, the industry's adaptability is such that even a major loss, such as Australia's total withdrawal from the market, could be absorbed without catastrophic perturbations. Moreover, utility inventories are of a size that makes them important surge tanks in the system.

Psychology—The belief once prevailed that production growth could not keep pace with consumption growth, that we could run out of uranium within a few decades, and that prices would skyrocket. A psychology developed that encouraged advance buying, utility investments in production, and conservative long-term contracts. Today, most buyers assume rightfully that uranium will be available at affordable prices. A relatively calm psychological atmosphere prevails.

Conclusions

The cycle of development for businesses of all types is that there is first an *innovative* phase, as an industry emerges; then a *growth* phase, as use expands; then a *shakedown* phase, during which marginal participants fall by the wayside as the strong prevail. And finally there is a *mature* phase, in which the strong provide stability.

I believe the uranium business is in the latter stages of the shakedown phase. We remain separated from the mature phase by: (1) the remaining inventory problem; (2) some further shaking out that might take place in eastern Canada; and (3) potential consolidation in Central Africa. The imbalance in supply and demand is less of a problem and inventory redistribution is underway via the secondary market.

I do not mean to suggest that all uncertainties will disappear. My message is that the controlling set of variables is changing and their range of uncertainty is narrowing. Nor do I mean to suggest that all the problems of the industry will be suddenly or permanently solved in the mature phase. But I do believe that firming demand, firming production, and the much higher level of sophistication in all quarters of the industry will make for a more stable, profitable, and less frustrating business. We have to be sure that our plans and policies are not designed to prepare us for the last war. The look ahead is different and—I think—a more enjoyable one for all.

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NUEXCO REPORT 182 FIGURES OF THE MONTH (September 30, 1983)	This Month (Report 182)	Last Month (Report 181)	12 Months Ago (Report 170)
Exchange Value[1]	24.00	24.00	17.00
Transaction Value[1]	23.65	23.60	17.30
Conversion Value[2]	1.00	1.10	1.10
Loan Use Charge Rate[3]	6%	6%	6%
Near-Term Uranium Supply[4]	7.2	6.7	3.3
Near-Term Uranium Demand[5]	4.4	2.4	0.66
Near-Term Supply-Demand Ratio	1.7	2.9	5.0
Recent Uranium Sales:			
Number of Transactions[6]	2	9	7
Quantity of Material[7]	0.1-0.35	1.8-3.9	0.8-2.0
Nuexco SWU Value:			
FY 84	90.0	95.0	—
USDOE SWU Prices:			
AFC	138.65	138.65	138.65
Requirements	149.85	149.85	149.85
Market Value of Enriched UF_6[9] [10]:			
2.5 w/o U_{235}	582.75	598.47	—
3.0 w/o U_{235}	743.24	764.27	—
3.5 w/o U_{235}	906.43	932.90	—
4.0 w/o U_{235}	1,071.62	1,103.64	—

[1]US $ per pound U_3O_8 equivalent
[2]US $ per pound U as UF_6
[3]Per annum
[4]Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8)
[5]Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).
[6]Uranium sales only; does not include loans, conversion, or SWU transactions.
[7]Millions of pounds U_3O_8 equivalent.
[8]US $ per SWU.
[9]Calculated using the Nuexco Exchange Value, Conversion Value, and 0.20 percent tails assay. Calculations before 2/28/83 used the USDOE price for AFC SWUs. As of 2/28/83, calculations use the Nuexco SWU Value for the relevant fiscal year (currently FY 84).
[10]US $ per KgU as UF_6.

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EXECUTIVE SUMMARY
REPORT 182

Exchange Value $24.00, unchanged

The **Exchange Value** as of September 30, 1983 is **$24.00** per pound U_3O_8, unchanged from last month. Two uranium sales transactions are reported, involving approximately 260 million pounds U_3O_8 *equivalent*. One transaction involved U_3O_8 and one involved UF_6.

Supply-Demand Ratio Fell to 1.7:1

Active spot and near-term **uranium supply** amounts to **7.2** million pounds U_3O_8, *equivalent*, up 500 thousand pounds from last month. **Active** spot and near-term **uranium demand** rose 83 percent, to **4.4** million pounds U_3O_8 equivalent. Therefore, the spot and near-term **supply-demand ratio** fell to **1.7:1.**

Transaction Value Rose $.05, to $23.65

The **Transaction Value** as of September 30, 1983, is **$23.65** per pound U_3O_8. It includes 21 transactions involving a total of 2.0 million pounds equivalent U_3O_8 and covers a period of six months.

Loan Use Charge Rate unchanged at 6%

The **Loan Use Charge Rate** as of September 30, 1983 is **6 percent** per annum. The entry of some new supply to the market in September is causing slight downward pressure on the loan rate, but no uranium loan transactions are reported.

Conversion Value decreased to $1.00

The **Conversion Value** as of September 30, 1983 is **$1.00** per pound U as UF_6, down $0.10 since last month. One secondary market conversion transaction is reported, involving 101-300 thousand pounds U as UF_6. Active supply has declined to approximately three times active demand. The Conversion Value definition was clarified this month to exclude costs associated with unusual transportation requirements.

SWU Value for FY84 $90, down $5

The SWU Value as of September 30, 1983 is **$90 per SWU**, down $5 since last month. The new price reflects aggressive offers to sell large quantities of Eurodif-origin SWUs. Spot and near-term demand for secondary market enrichment services amounts to 1.4 million SWUs; spot and near-term supply amounts to 1.7 million SWUs. This issue reports three sales of enrichment services, involving a total of 200 thousand USDOE-origin SWUs.

Enrichment

DOE's Interim Sales Contract has caused some thinning of the secondary SWU market, but the large number of utilities that have not signed it continue to represent significant market potential.

Canada

The Canadian government will leave its uranium export policy virtually as is. Some CANDU reactors have suffered unaccustomed operating problems.

Japan

Japan's utilities set successive records for power generation this summer while simultaneously their 24 commercial reactors established a new record for availability.

Spain

Two new PWRs have joined the grid and Almaraz 1 is operational again.

United States

The long-awaited Oak Ridge meeting at which DOE is to unveil the new Utility Services enrichment contract has been delayed again, and the delay has given rise to some interesting questions.

Commentary

DOE's customers should understand clearly the DOE cost structure prior to making significant decisions on future enrichment services.

Analysis & Commentary

This Report summarizes the terms and conditions of six DOE enrichment contract types.

Analysis & Commentary

Nuexco's current forecasts of nuclear electric generating capacity, uranium consumption, production and supply-demand balance indicate that an unprecedented degree of stability lies ahead.

Analysis & Commentary

This Report describes the organizational structure of the Federal Energy Regulatory Commission, the US government's most powerful utility regulatory body.

Raw Materials

Cogema produces approximately one third of annual French domestic production from structurally formed sedimentary basins in the Lodeve district of southern France.

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